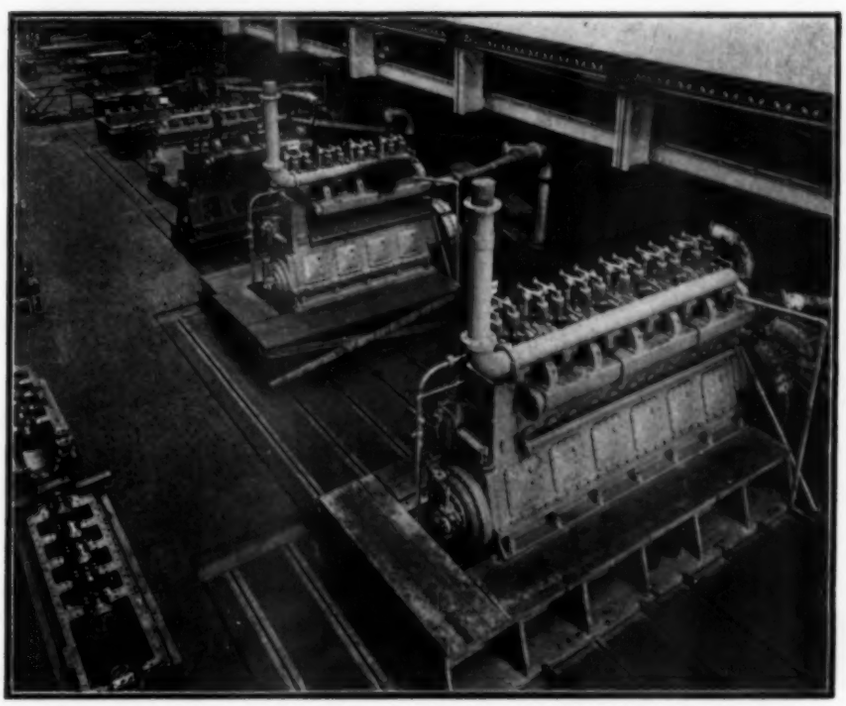
American Machinist

June 6, 1934

Interchangeability in Diesel Engine Manufacture—I

JOHN HAYDOCK
Managing Editor

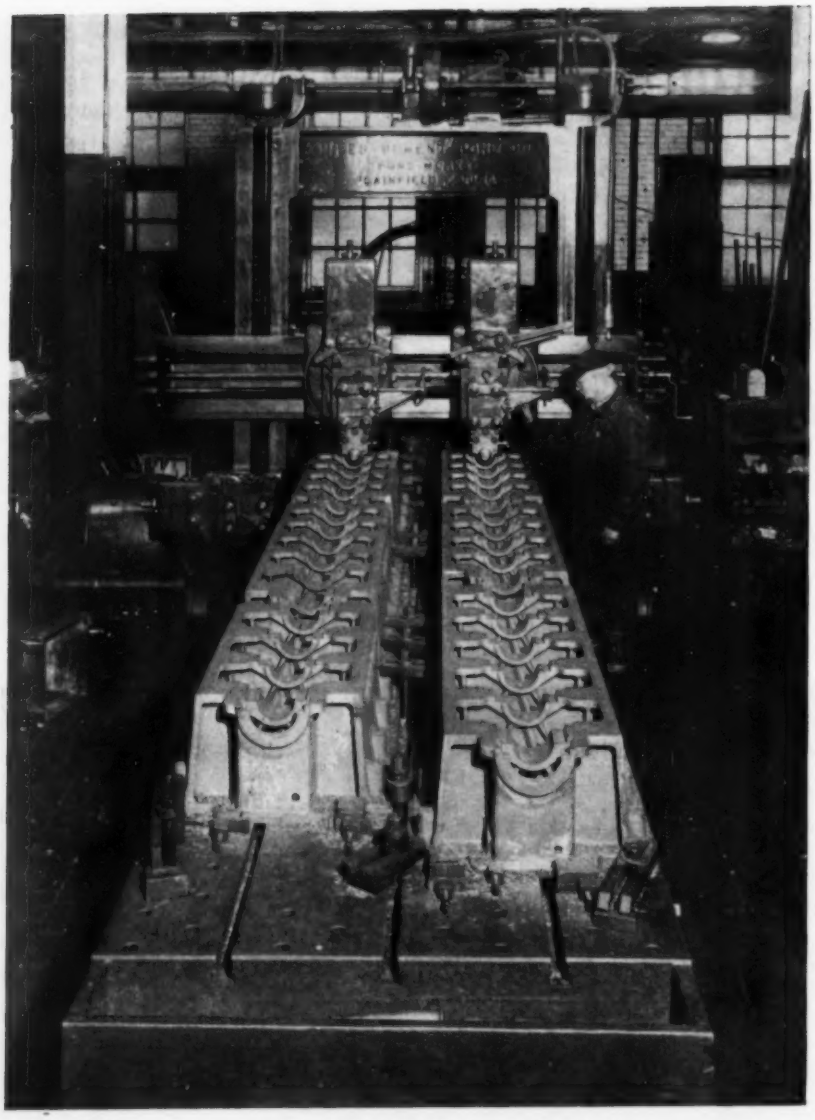
Adoption of a standardized line of diesel engines made possible the extensive use of jigs and fixtures in the Buffalo plant of the Worthington Pump & Machinery Corporation. The economy in manufacture which resulted is shown by examples of machining operations on the key parts



After assembly each engine is given a thorough-going running test before being released by the inspectors

THE MANUFACTURING background of the Buffalo Works of the Worthington Pump & Machinery Corporation extends back to 1859, when the Holly Manufacturing Company was originally formed. The year 1934, therefore, marks the 75th anniversary of a works which has continuously manufactured heavy pumping machinery and prime movers. The Holly water works, the Holly pumping engines, the Snow gas engines and later Worthington gas and diesel engines became products of world wide renown and have clearly established this organization as heavy machinery builders using sound production methods.

Appreciation of the market for the highly efficient oil burning diesel engine induced Worthington to take up the manufacture of these units as one of its principal products. During the first few years of this century when exclusive license to build such engines was held by another company, engines were built under contract for that company but later, as the basic patents expired, engines of Worthington design were developed. These engines, depending on the service required, were either two or four cycle, horizontal or vertical, air or solid injection, single or double acting, for stationary or marine service. The production of such a variety of types, although ideal from the consumer's viewpoint, did not fit modern methods.



Chain-driven rotary tools plane the half cylindrical bearing seats in accurate alignment with the other finished surfaces in the bed plate

After building various types of diesel engines for more than twenty years, the need of standardization became apparent. By carefully reviewing the merits of each particular design which had been built up to that time, it was decided that the greatest over-all worth to the purchaser would result from the use of a four cycle direct injection, vertical engine. The reasons underlying the selection of this type of engine as a final design, justifying elaborate preparations for production, are outside the range of this presentation. It need only be pointed out that the diesel engines of this type, which have been manufactured during the last few years, are piling up records for efficient and continuous performances in many parts of the world.

The necessity of providing a wide range of capacities resulted in the adoption of five standard cylinder sizes, each of which is manufactured in certain groups of cylinders. The standard sizes are 25, 50, 75, 100 and 125 hp. per cylinder, and these are in turn built in engines having from 1 to 12 cylinders. The result is a wide range of sizes from 25 to 1500 hp. with each engine operating at a rotative speed most satisfactory for its size.

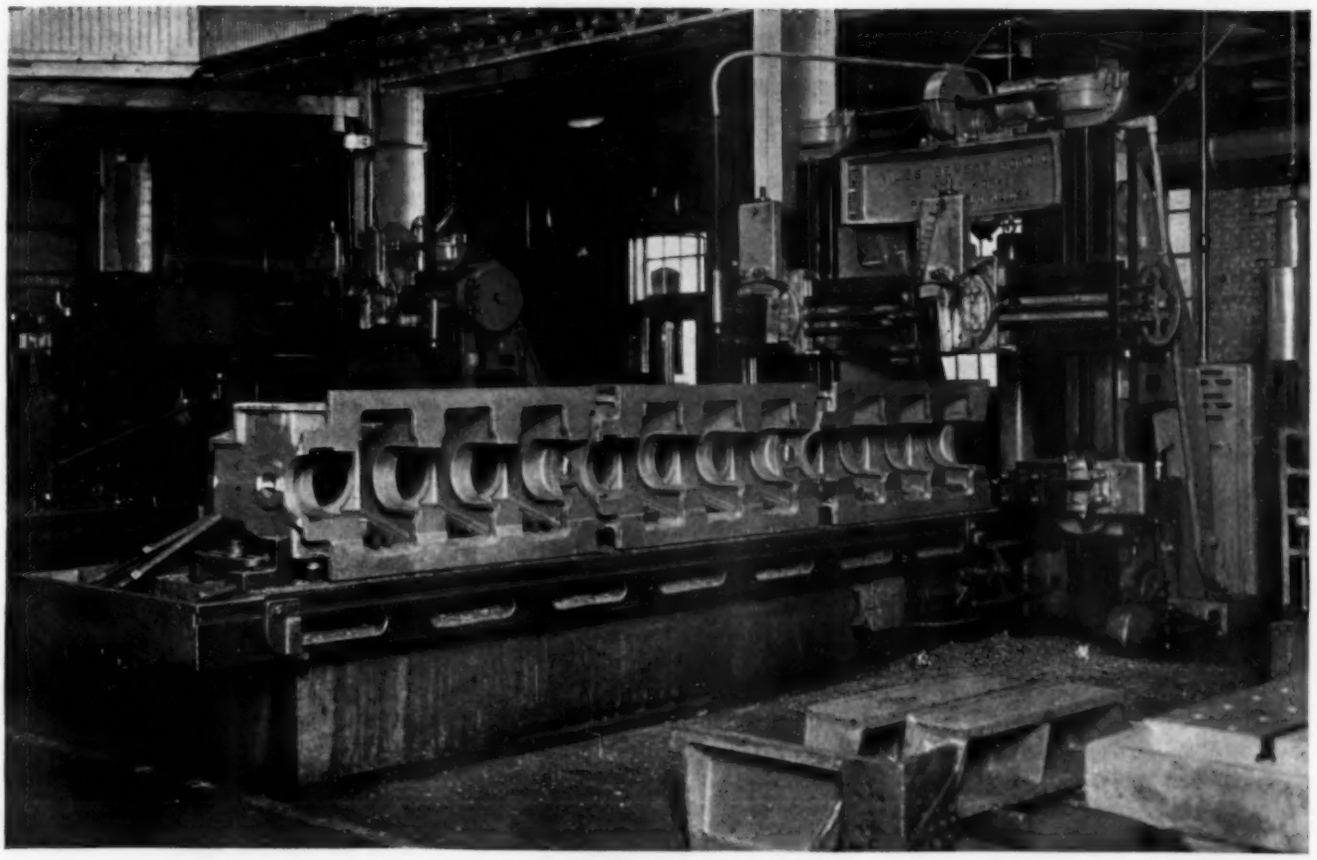
In addition to the superior performance realized from these new lines, manufacturing conditions were greatly improved. Bedplates, frames, and camshaft housings, though varying in length with the number of cylinders specified, have a uniform cross-section for each size of cylinder. Thus pattern costs were reduced by making the patterns in sections and building up these sections to the length required for each engine. In machining the castings, the full capacity of the machines is made useful by ganging the castings. Smaller parts, such as cylinder liners, pistons, connecting rods and cams, which are common for each size of cylinder, are machined in large quantities and stocked. Another feature of the design is that most of the major engine parts are used for both diesel and gas engines. Changing a few parts converts a diesel into a gas engine or vice versa.

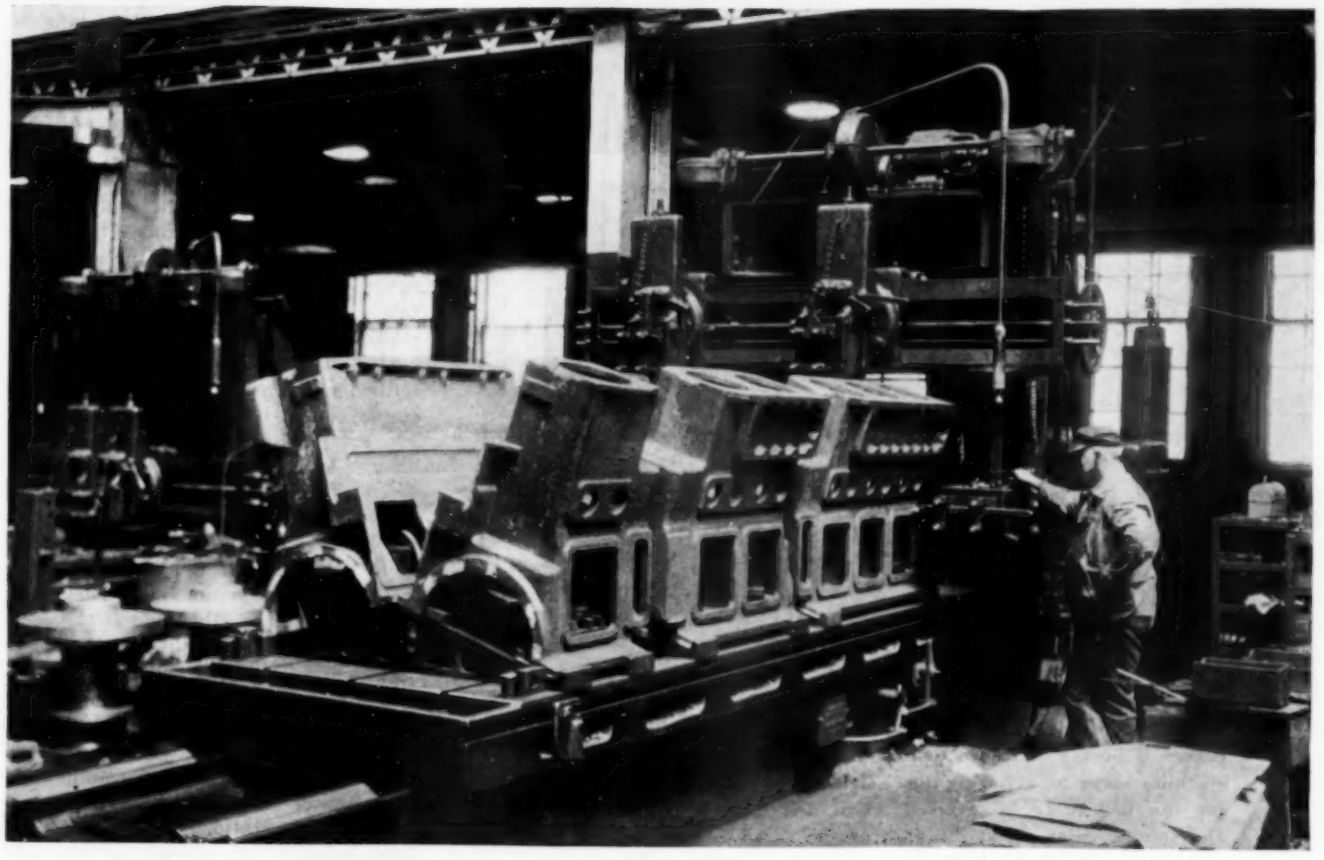
Stocking parts necessitates interchangeability. Jigs, fixtures and gages were built for the manufacture of nearly every part. The characteristics of these new units permitted this, for reasons outlined above, contrary to former designs when a tooling program for the many diverse lines was prohibitive on account of enormous cost. The advantages of producing interchangeable parts are obvious. Manufacturing costs were greatly reduced, fitting and mating of individual components were largely eliminated and assembly time was diminished. Machining the parts to jigs also assures that replacements fit into place, thus simplifying the problem of overhaul and repair, a marked advantage which is particularly important in marine work.

Manufacturing Facilities Coordinated

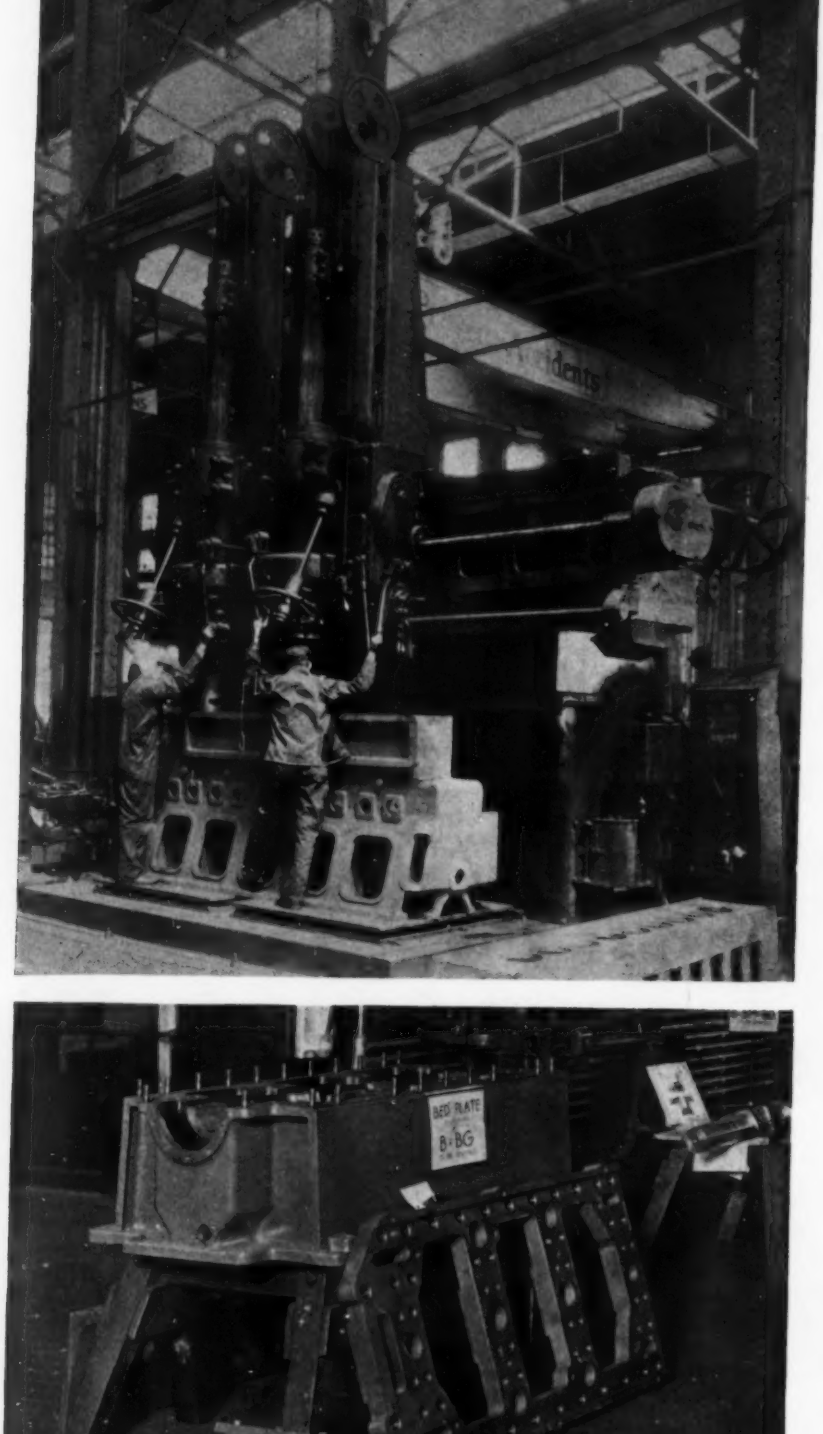
A part of the tooling program was to concentrate responsibility for tool design and toolroom operation under one man. While such a move necessarily means finding the right man, in this case, the results were highly satisfactory. At the time the new diesels were put into production, it was also found wise to consolidate all engine manufacture at the Buffalo plant. Accordingly, the best equipment from the East Cambridge plant was moved to Buffalo and the machinery rearranged to afford ample working space and the correct flow of material through the shop. In order that the practical results of this manufacturing set-up may be visualized, the operations on some of the important parts for the diesel engines will be described.

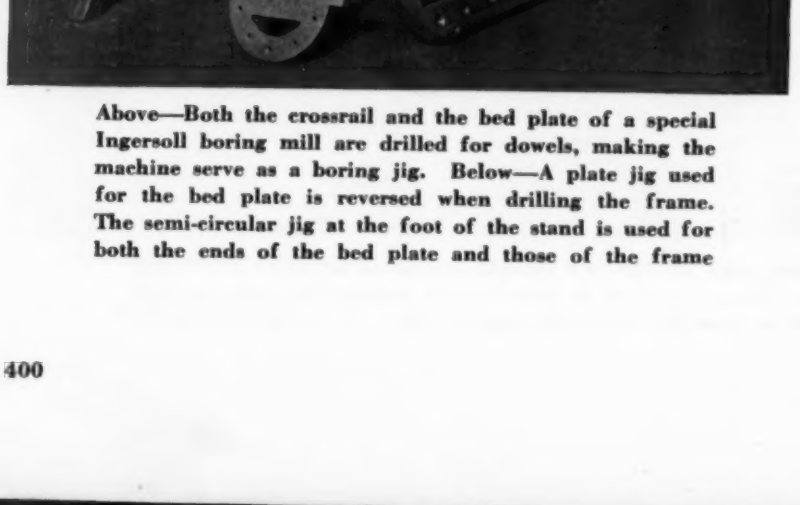
Before any machining operations are performed, bed plate castings are given a water test to insure freedom from leakage. They are then set upside-down on a 60-in. Niles planer, and the bottom is rough and finished planed. The bed plates are then set on the finished bottom in two rows. In this operation the top, the bearing cap fit and the half cylindrical surface for the bottom bearing shells are rough and finished planed. For the cylindrical surface a special radius planing tool is employed. It consists of a pivoted toolholder clamped to the clapper bar and driven by a worm and wheel through chain and sprockets from the feed shaft of the planer. The result is the generation of a cylindrical surface that is in





Above—Main frames are set up on their sides for the first planing operation, in which four heads are used. Below—Standardized design makes it possible to plane engine frames with different numbers of cylinders in one setting. Inspection cover pads are being roughed out in the operation illustrated





Above—Both the crossrail and the bed plate of a special Ingersoll boring mill are drilled for dowels, making the machine serve as a boring jig. Below—A plate jig used for the bed plate is reversed when drilling the frame. The semi-circular jig at the foot of the stand is used for both the ends of the bed plate and those of the frame

positive alignment with the other planed surface and is uniform throughout its length. It was found that when a boring bar is used to finish a long series of half holes, there is a spring in the bar resulting in misalignment which has to be corrected by the expensive process of hand scraping. The planing method has proven highly satisfactory, and the bearing shell seats on all size frames are produced that way.

The next operation is to drill, tap and ream the top of the bed plate; also to drill and spotface the foundation bolt holes. This is done on a 6-ft. radial drill with a plate drill jig located from the main bearing cap fit. The same setup includes fittting the main bearing studs. Facing the ends and sides of the main bearing and boring the ends is done after assembly with the frame and will be described later.

When the main frame comes from the foundry it is first set on its side on a 60 in. Niles planer. Loading the table to its capacity, the bottom, one side of the bottom flange and the camshaft housing pad are rough and finished planed; the top is only rough planed. Use of the four heads simultaneously makes this an ideal planer job. For the second operation the frame is clamped with the bottom against the table, using the finished side of the flange as means of alignment by pushing it against stops set into the T-slots of the table. Loading the table with two rows of frames and again employing all four heads, the top is finished planed, the water service and exhaust manifold pads, as well as the oposite side of the bottom flange, is rough and finished planed. Tilting the frames by means of tapered parallels brings the inspection cover pads vertical. A straight cut is taken with the two side heads of the planer.

On all planing operations just described O.K. gooseneck tool holders are employed.

A Double-Action Jig

Next in order is a drilling operation on a Cincinnati-Bickford radial drill. Here the holes in the bottom of the frame are drilled, reamed and back spotfaced. Using the other side of the same plate drill jig that drills the bed plate and locating from the sides of the bottom flange assure that the holes, especially the two dowel holes which each frame and bed plate receives, are in perfect alignment. The accuracy of these dowel holes is paramount as all subsequent operations are worked from these holes.

The next operation is to bore, counterbore and chamfer the holes for the cylinder liners. For this purpose the

frame is set up in a specially built Ingersoll two-spindle vertical cylinder boring machine, using the machine itself as a fixture. Dowel holes have carefully been laid out in the base of the machine. Using the two dowel holes in the frame and two dowels in the base of the machine brings the frame in positive position. The crossrail of the baring machine is similarly laid out with dowel holes at the proper relation to the holes in the base. An index pin, passing through the boring head, locates each head correctly for the first hole after which the boring heads are again indexed to the next hole, always using the index pin in the boring head for correct setting. Cutter heads of the flat cutter type are used for boring and facing with stops to control the depth of the counter bore.

Frame and base now move together to a floor type horizontal boring mill. They are temporarily assembled and the ends are bored and faced. In the same set-up the pad for the camshaft cover and the idler gear flange is face milled. The frame is then taken off its base and the sides of the main bearings are faced. From here the base goes to a horizontal drilling machine where both ends are drilled, tapped and and the studs driven.

"Our Accomplishments—Our Inventions"

ALFRED M. WASBAUER

Though "invention" is ofttimes a poor copy, the Soviet Union exhibits its progress in machine tool manufacture

AN EXPOSITION, called "Our Accomplishments, Our Inventions," has just closed in the Polytechnic Museum of Moscow. Within the two sections, every Russian product was exhibited, and in many cases, the mode of production was cleverly revealed by means of miniature reproduction of plants, processes and equipment. For instance, a miniature cross-section to scale of a mine thoroughly revealed a new process of burning coal underground. Close by, an immense map studded with 500 miniature lamps was wired to show the various locations in which 25 minerals are found and mined. On the walls were illuminated photo panels, several meters square, of the various new industries. When it comes to advertising, the Russians are not far behind us.

The machine tool exhibit was located in the section designated "Our Inventions." A small photo catalog of the machines now building and to be built consisted in part of photos of venerable foreign machines. One recognized a drum type miller built in 1919, a Fellows gear shaper of about the same vintage, and others.

We now came to the exhibit of the Red Proletarian factory, in Moscow, about the most advanced machine tool factory in Russia. Here were polished samples of efficient machine tools: improved 12- and 18-in. Sundstrand stub lathes; the No. 56 Sundstrand centering machine; the Lorenz gear shaper which gives automotive engineers a headache, since they are partial to Fellows, and two sizes of the geared head V.D.F. German engine lathe, 8- and 12-in. swing and 1 and 1.5 meters between centers; also a three-step cone head engine lathe, motor driven through a Löwe three-speed transmission. The total production of the Red Proletarian factory in 1933 was 2,250 machines; the number of productive workers was 2,200. Hereinafter, all figures refer to productive workers as distinguished from the clerical force.

We walked into the next room and there found a 3-hp. brass chucking lathe and a pipe flange thread miller from a factory in Samara. They produced 400 machines in 1933 with 600 men. Close by is an American toolroom lathe all shined up. It is made by the Mongolian people, named Udmurt, at the Ijevsk works. As no production figures are given, we may assume that this is still a project. The same may be said of a Cincinnati Bickford radial drill and a German Fortuna cylindrical grinder of one meter table travel.

Then came a group of electric hand drills made by a commune of homeless waifs in Kharkov. They will run an hour or two; this is "Our Inventions."

A hopper-fed automatic screw slotting machine from Dniepropetrovsk next drew the attention of hundreds of students. Nothing like this had ever before been seen in Russia. In the same group were a precision bench lathe and hand screw machine from the Dzerjinski works at Perm.

Small tools were well represented. They moved before one on an endless belt, and I cannot think of any tool made in America which is not shown here, even to Johannson gage blocks, which do not stick together more than three weeks in Russia.

Now here was a funny one. This would have thrilled me as a youngster steeped in inventiveness; it was nothing less than an anomalous combination of lathe, driller, miller and shaper copied after the inventive German Franc Braun. It would not make autos, but it caught the attention of the crowd. This and a gear hobbing machine of the Pfauter type came from an aprentice training school at Gregoryevsk. The gear hobber was already down for repairs.

Next came a Hahn & Kolb "Index" automatic screw machine from the war plant Frunze, at Penza. It shone like a jewel and worked so fast that crowds stood agape before it. It was evident that war plants had higher skill, for their machines stand out from the others in finish and accuracy.

One saw now an 80-mm. spindle boring machine from the Sverdlov plant in Leningrad. Their production was 450 machines in 1933 with 1800 workers.

Going through quickly, we saw drill presses copied somewhat after Baker and Colburn, and recognized at once a Landis pipe-threading machine. All this came from the Lenin plant in Odessa. Their production in 1933 was 2,000 machines with 1,000 workers.

From Plant 25 in Gooyap came a replica of the Michigan Tool Company's grinding machine for gear shaper cutters. Mr. Fowler, formerly of that firm, has supplied consistently well ground cutters to the automotive industry.

The plant Samotochko in Moscow con-

tributed two shapers of 20- and 26-in. stroke respectively and a slotter of 7-in. stroke. Their production in 1933 was 800 machines with 625 workers.

A war plant in Tula contributed a highly polished Cincinnati type universal milling machine with an 8x36-in. table. No production figures were available of course. The same machine was made in a Gorki (Nijni Novgorod) plant, but did not shine as well. Still, their production in 1933 was 400 machines with 1,100 workers. Up to the third trimester of 1933, they had produced only 240 machines. This is explained by the usual heavy rush to meet the plan at the end of fixed periods.

Next in line were two Warner & Swasey turret lathes of 63- and 85-mm. bar capacity, and a German automatic Scheu for ball bearing races. Their production in 1933 was 450 machines with 1400 men. Believe it or not, the figure for April this year was over 100 machines, but try to get automotive engineers to use them.

As evidence of Russian capacity for self-criticism, there was a complaint book located at each exhibit. These books hold the complaints of the customers about the machines they received. Almost all complain, regardless of the type of machine, of large blow holes in the tables, slides and ways, filled with babbit which falls out during assembly or initial operation. A typical complaint from a customer for a Warner & Swasey replica is as follows:

Clutches do not work; automatic stops do not work; spindle brake does not work; pump does not work; spindle does not stop; driving keys left out; adjustable taper bearing distorted; poor fitting, poor scraping, poor finish; turrets do not line up; locating bushings soft and loose in their seats; carriage feeds with lever in neutral; turret and spindle out of line 0.4 mm.; noisy head.

Otherwise machine is all right.

In spite of this, every effort is being made to reduce machine imports to an irreducible minimum this year and in future. There is no complete agreement among the directors of heavy industry about the quantity of machine tool imports allowable, but the figure will not compare to that of 1930. The magnitude of this figure will depend upon the outcome of the controversy now raging between the directors of automotive plants and the Commissariat of Heavy Industry, the former insisting on a greater percentage of American machine tools in order to fulfill their plan than the latter will allow them.

Detailed Specifications Retard Progress

JOHN R. GODFREY

SPECIFICATIONS are funny animals. Drawn with the earnest desire to secure the best possible product, they frequently have just the opposite effect. With memories of sad experiences when loosely drawn specifications resulted in unscrupulous bidders extracting the gold from his teeth, the purchaser who was stung goes to the other extreme. Specifications are drawn that cover every last detail down to the kind of metal in the name plate. But such specifications are full of dynamite, for various reasons.

The basis for specifications is of necessity the result of past experience. In too many cases they are drawn, in all honesty, around a machine that has given satisfaction in use. What is more natural than to include the features we have found useful, especially if our experience with machines of this type is limited. We forget that it is quite possible that much better machines are already in existence but that we are not familiar with them. And who can know what improved features may be in the offing?

There are cases also where shrewd, and not altogether altruistic, salesmen have generously helped to draw specifications that included the features of their machines and carefully barred every competitor. But even assuming that all detailed specifications are honestly drawn, they are still dangerous when they go into too many details. In many cases the very care taken to insure getting a good machine makes it impossible for the builder of the best even to enter a bid.

Purchasers of machines or other equipment for government departments or for large corporations must be doubly careful. Not only are they likely to be accused of graft or collusion but for some unexplained cause many otherwise patriotic citizens seem to feel that gouging their government is the highest form of shrewd business practice. Then, too, the intended safeguard of favoring the lowest bidder has its drawbacks. All too frequently the lowest bid means lack of experience, inadequate facilities and probably unbusinesslike management.

Reliability of a product and responsibility of the builder are usually of greater importance than any saving to be made in the cost of a machine. Reputation should play a major part in important purchases, especially for government bureaus. But when detailed specifications are drawn, covering minute details of design and construction, these, coupled with award to the lowest bidder, usually mean dissatisfaction to all.

Lack of knowledge of all the developments being made by progressive machine builders makes it impossible to draw detailed specifications that will not bar them from the competition. This of itself prevents the purchase of the most improved machine equipment as it limits bidding to the machines known to the specification maker at the time they are drawn. In cases where the specifications are made by those not thoroughly familiar with the subject, as frequently happens in government purchases, impractical and conflicting requirements creep into the details.

What is the solution of the problem?

Briefly, there should be a radical change in method. Specifications should, with few exceptions, avoid details of design or construction. General dimensions as to capacity and results are the real points at issue. Satisfactory performance should be made the responsibility of the maker, backed up if necessary by a bond that holds for a suitable period. This requirement would probably eliminate the "low bidder" who takes a chance on both delivery and performance. Only makers of known reputation should be considered, this provision being flexible enough to include such cases as responsible men who have started a new company.

Specify results and have them guaranteed. Do not hamper progressive builders by asking them to build machines that have become obsolete without your knowing it. Only in this way can you be sure of getting the best equipment. How else can progressive builders be encouraged. This is a good time to eliminate the chiseler who offers to copy an old design at a price that precludes development work of any kind.

Insist on results and see that they are guaranteed. Leave the details to the man who is responsible for the performance of the machine!

Should American Industry Adopt ISA Standard Fits?

Is an international standard of fits desirable?

Is the system already adopted by France and Germany suitable for use in this country?

JOHN GAILLARD
Mechanical Engineer, American Standards Association

The author outlines the European standard so that those interested in the current revision of our own standard may be guided in their answers to these questions

AN AMERICAN tentative standard for fits between cylindrical parts was set up in 1925 under the procedure of the American Standards Association[1]. The ASA committee that developed it was reorganized in 1930 to determine whether the standard should be revised or supplemented in view of the progress made during the five years of its existence.

A subcommittee of the new ASA committee[2] decided last year that due consideration should be given to a proposal developed by a technical committee of the International Standards Association,[3] the first part of which has now practically reached its final shape. This gives a series of recommended fits for nominal diameters from about 0.04 to 7 in. (1 to 180 mm.), or almost the same range as covered by the American tentative standard of 1925 (⅛ to 8½ in.) for classes of fit 1 to 6, inclusive. The ISA fits in question will be reviewed in the present article. The ISA committee has also completed a draft of limits for parts up to 500 mm. (about 20 in.), and a preliminary study of limits for parts up to 1600 mm. (about 63 in.).

Structure of the ISA System

Although the designer is concerned with the values of allowances and tolerances rather than with the manner in which the system of fits is built up, the structure of the ISA system deserves attention for the following reason. The ISA committee realized that the proper values of allowances and tolerances must be based on practical experience and cannot be derived from mathematical formulas. Nevertheless, it made an effort to systematize the practical data as much as possible. This has led to the adoption of a tolerance unit expressed by the formula:

$$i = 0.52\sqrt[3]{D} + 0.01\,D$$

in which i is the tolerance unit in ten thousandths of an inch, and D the nominal diameter in inches. For example, the tolerance unit for an 8-in. hole or shaft is 1.12 tenths, or 0.000112 in. Furthermore, the standard holes and shafts of the ISA system are divided into series, each of which has a specific grade of tolerance. This means that the tolerance on each hole or shaft of a specific series equals a definite number of tolerance units.

There are sixteen tolerance grades, with the symbols IT 1 to IT 16. Seven of these grades (IT 5 to IT 11, inclusive) are meant primarily for holes and shafts to be fitted together. The four finest grades (IT 1 to IT 4, inclusive) are intended mainly for limit gages, but also for production work of exceptional accuracy. The five coarsest grades (IT 12 to IT 16, inclusive) which comprise tolerances as given, for example, on products finished by rolling, drawing and milling, are not meant for parts required to give a specific fit.

The tolerance grades IT 5 to IT 11, inclusive, are listed below, together with their values expressed in tolerance units.

Tolerance Grade	Value	Tolerance Grade	Value
IT 5	about 7i	IT 9	40i
IT 6	10i	IT 10	64i
IT 7	16i	IT 11	100i
IT 8	25i		

For a given nominal diameter, the tolerance according to grades IT 6 to IT 11, inclusive, form a geometric series with a ratio of about 1.6[4]. Incidentally, this applies also to the grades IT 12 to IT 16, inclusive, whose values range from 160i to 1000i, being ten times the respective values of the grades IT 7 to IT 11, inclusive.

Standard Holes and Shafts

In principle, the standard holes and shafts of the ISA system are meant to be combined at will to give the required fit. At first, the ISA committee had in mind to leave this combination entirely to the judgment of the designer, but later on it decided to recommend a

[1] Tolerances, Allowances and Gages for Metal Fits (B4a-1925.)

[2] Subcommittee members: R. E. W. Harrison, chairman; P. V. Miller, secretary; F. E. Banfield; H. B. Hambleton; F. O. Hoagland; W. C. Mueller; D. W. Ovaitt; and H. Van Keuren.

[3] The ISA is a federation of national standardizing bodies in eighteen countries, including the ASA. Its main purpose is to make recommendations for the unification of national standards. Adoption of these recommendations by the member bodies of the ISA is voluntary.

PROPOSED ISA SYSTEM OF FITS

Table I, Basic Hole System

Limits in tenthousandths of an inch

Nominal Diameter (inches)		Hole H6 basic to	SHAFT LIMITS												Hole H7 basic to	SHAFT LIMITS													
from	to [1]		g5		h5		j5		k5		m5		n5			d9		e8		f7		g6		h6		j6		k6	
0.04	1/8	+3	-1	-3	0	-2	+1.5	-0.5			+3	+1	+4	+2.5	+3.5	-8	-18	-6	-11	-3	-6	-1	-4	0	-3	+2.5	-0.5		
1/8	1/4	+3	-1.5	-3.5	0	-2	+1.5	-0.5			+3.5	+1.5	+5	+3	+5	-12	-24	-8	-15	-4	-9	-1.5	-5	0	-3	+3	-0.5		
1/4	3/8	+3.5	-2	-4	0	-2.5	+1.5	-1	+3	+0.5	+5	+2.5	+6	+4	+6	-16	-30	-10	-19	-5	-11	-2	-6	0	-3.5	+3	-1	+4	+0.5
3/8	11/16	+4	-2.5	-5.5	0	-3	+2	-1	+3.5	+0.5	+6	+3	+8	+5	+7	-20	-37	-13	-23	-6	-13	-2.5	-7	0	-4	+3	-1	+5	+0.5
11/16	1 1/4	+5	-3	-6	0	-3.5	+2	-1.5	+4	+1	+7	+3	+9	+6	+8	-26	-46	-16	-29	-8	-16	-3	-8	0	-5	+3.5	-1.5	+6	+1
1 1/4	2	+6	-3.5	-8	0	-4	+2.5	-2	+5	+1	+8	+3.5	+11	+7	+10	-31	-56	-20	-35	-10	-20	-3.5	-10	0	-6	+4	-2	+7	+1
2	3 1/4	+7	-4	-9	0	-5	+2.5	-3	+6	+1	+9	+4	+13	+8	+12	-39	-69	-24	-42	-12	-24	-4	-11	0	-7	+5	-3	+8	+1
3 1/4	4 3/4	+9	-5	-11	0	-6	+2.5	-3.5	+7	+1	+11	+5	+15	+9	+14	-47	-81	-28	-50	-14	-28	-5	-13	0	-9	+5	-3.5	+10	+1
4 3/4	7	+10	-6	-13	0	-7	+3	-4	+8	+1	+13	+6	+18	+11	+16	-57	-96	-33	-58	-17	-33	-6	-15	0	-10	+6	-4	+11	+1

Hole H7 basic to	SHAFT LIMITS																											
	m6		n6		p6 [2]																							
+ 3.5	+3.5	+1	+5	+2.5	+6	+3.5																						
+ 5	+5	+1.5	+6	+3	+8	+5																						
+ 6	+6	+2.5	+7	+4	+9	+6																						
+ 7	+7	+3	+9	+5	+11	+7																						
+ 8	+8	+3	+11	+6	+14	+9																						
+ 10	+10	+3.5	+13	+7	+17	+10																						
+ 12	+12	+4	+15	+8	+20	+13																						
+ 14	+14	+5	+18	+9	+23	+15																						
+ 16	+16	+6	+20	+11	+27	+17																						

Nominal Diameter (inches)		Hole H8 basic to	SHAFT LIMITS																									
from	to [1]		d10		e9		f8		h8		h7		j7		k7		m7		n7									
0.04	1/8	+ 6	-8	-24	-6	-15	-3	-8	0	-6	0	-3.5	+3	-1					+6	+2.5								
1/8	1/4	+ 7	-12	-31	-8	-20	-4	-11	0	-7	0	-5	+3.5	-1					+8	+3								
1/4	3/8	+ 9	-16	-39	-10	-24	-5	-14	0	-9	0	-6	+4	-2	+6	+0.5	+8	+2.5	+10	+4								
3/8	11/16	+ 11	-20	-47	-13	-30	-6	-17	0	-11	0	-7	+5	-2.5	+7	+0.5	+10	+3	+12	+5								
11/16	1 1/4	+ 13	-26	-59	-16	-36	-8	-21	0	-13	0	-8	+5	-3	+9	+1	+11	+3	+14	+6								
1 1/4	2	+ 15	-31	-71	-20	-44	-10	-25	0	-15	0	-10	+6	-4	+11	+1	+13	+3.5	+17	+7								
2	3 1/4	+ 18	-39	-87	-24	-53	-12	-30	0	-18	0	-12	+7	-5	+13	+1	+16	+4	+20	+8								
3 1/4	4 3/4	+ 21	-47	-102	-28	-63	-14	-35	0	-21	0	-14	+8	-6	+15	+1	+19	+5	+23	+9								
4 3/4	7	+ 25	-57	-120	-33	-73	-17	-42	0	-25	0	-16	+9	-7	+17	+1	+22	+6	+26	+11								

Hole H11 basic to	SHAFT LIMITS									
	a12 [2]		b11 [2]		c11 [2]		d11 [2]		h11	
+ 24	- 33	- 69	- 20	- 44	- 13	- 36	- 8	- 31	0	-24
+ 30	- 51	- 98	- 31	- 61	- 19	- 48	- 12	- 41	0	-30
+ 35	- 71	- 130	- 41	- 77	- 26	- 61	- 16	- 51	0	-35
+ 43	- 91	- 161	- 55	- 98	- 33	- 77	- 20	- 63	0	-43
+ 51	- 122	- 205	- 71	- 122	- 41	- 93	- 26	- 77	0	-51
+ 63	- 157	- 256	- 91	- 154	- 53	- 116	- 31	- 94	0	-63
+ 75	- 197	- 315	- 114	- 189	- 69	- 144	- 39	- 114	0	-75
+ 87	- 252	- 390	- 142	- 228	- 83	- 169	- 47	- 134	0	-87
+ 98	- 307	- 465	- 173	- 272	- 98	- 197	- 57	- 156	0	-98

Table II, Basic Shaft System

Limits in tenthousandths of an inch

Nominal Diameter (inches)		Shaft h5 basic to	HOLE LIMITS												Shaft h6 basic to	HOLE LIMITS													
from	to [1]		G6		H6		J6		K6		M6		N6			D9		E8		F7		G7		H7		J7		K7	
0.04	1/8	- 2	+1	+4	0	+3	-1.5	+1			-3	0	-4	-1.5	- 3	+8	+18	+6	+11	+3	+6	+1	+5	0	+3.5	-2.5	+1		
1/8	1/4	- 2	+1.5	+5	0	+3	-1.5	+1.5			-3.5	-0.5	-5	-2	- 3	+12	+24	+8	+15	+4	+9	+1.5	+6	0	+5	-3	+2		
1/4	3/8	- 2.5	+2	+6	0	+3.5	-1.5	+2	-3	+1	-5	-1	-6	-3	- 3.5	+16	+30	+10	+19	+5	+11	+2	+8	0	+6	-3	+3	-4	+2
3/8	11/16	- 3	+2.5	+7	0	+4	-2	+2.5	-3.5	+1	-6	-1.5	-8	-3.5	- 4	+20	+37	+13	+23	+6	+13	+2.5	+9	0	+7	-3	+4	-5	+2.5
11/16	1 1/4	- 3.5	+3	+8	0	+5	-2	+3	-4	+1	-7	-1.5	-9	-4	- 5	+26	+46	+16	+29	+8	+16	+3	+11	0	+8	-3.5	+5	-6	+2.5
1 1/4	2	- 4	+3.5	+10	0	+6	-2.5	+4	-5	+1	-8	-1.5	-11	-5	- 6	+31	+56	+20	+35	+10	+20	+3.5	+13	0	+10	-4	+6	-7	+3
2	3 1/4	- 5	+4	+11	0	+7	-2.5	+5	-6	+1.5	-9	-2	-13	-6	- 7	+39	+69	+24	+42	+12	+24	+4	+16	0	+12	-5	+7	-8	+3.5
3 1/4	4 3/4	- 6	+5	+13	0	+9	-2.5	+6	-7	+1.5	-11	-2.5	-15	-6	- 9	+47	+81	+28	+50	+14	+28	+5	+19	0	+14	-5	+9	-10	+4
4 3/4	7	- 7	+6	+15	0	+10	-3	+7	-8	+1.5	-13	-3	-18	-8	- 10	+57	+96	+33	+58	+17	+33	+6	+21	0	+16	-6	+10	-11	+5

Shaft h6 basic to	HOLE LIMITS													
	M7		N7		P7 [2]									
- 3	-3.5	0	-5	-1.5	-6	-3								
- 3	-5	0	-6	-1.5	-8	-3								
- 3.5	-4	+2	-6	0	-7	-1.5	-9	-3.5						
- 4	-5	+2.5	-7	0	-9	-2	-11	-4						
- 5	-6	+2.5	-8	0	-11	-3	-14	-6						
- 6	-7	+3	-10	0	-13	-3	-17	-7						
- 7	-8	+3.5	-12	0	-15	-3.5	-20	-8						
- 9	-10	+4	-14	0	-18	-4	-23	-9						
- 10	-11	+5	-16	0	-20	-5	-27	-11						

Nominal Diameter (inches)		Shaft h7 basic to	HOLE LIMITS												Shaft h8 basic to	HOLE LIMITS													
from	to [1]		H8		J8		K8		M8		N8					D10		E9		F8		H8							
0.04	1/8	-3.5	0	+6	-3	+3					-6	-0.5	- 6	+8	+24	+6	+15	+3	+8	0	+6								
1/8	1/4	- 5	0	+7	-3.5	+3.5					-8	-1	- 7	+12	+31	+8	+20	+4	+11	0	+7								
1/4	3/8	- 6	0	+9	-4	+5	-6	+2.5	-8	+0.5	-10	-1	- 9	+16	+39	+10	+24	+5	+14	0	+9								
3/8	11/16	- 7	0	+11	-5	+6	-7	+3	-10	+1	-12	-1	- 11	+20	+47	+13	+30	+6	+17	0	+11								
11/16	1 1/4	- 8	0	+13	-5	+8	-9	+4	-11	+1.5	-14	-1	- 13	+26	+59	+16	+36	+8	+21	0	+13								
1 1/4	2	- 10	0	+15	-6	+9	-11	+5	-13	+2	-17	-1	- 15	+31	+71	+20	+44	+10	+25	0	+15								
2	3 1/4	- 12	0	+18	-7	+11	-13	+6	-16	+2	-20	-1.5	- 18	+39	+87	+24	+53	+12	+30	0	+18								
3 1/4	4 3/4	- 14	0	+21	-8	+13	-15	+6	-19	+2.5	-23	-1.5	- 21	+47	+102	+28	+63	+14	+35	0	+21								
4 3/4	7	- 16	0	+25	-9	+16	-17	+8	-22	+3	-26	-1.5	- 25	+57	+120	+33	+73	+17	+42	0	+25								

Shaft h11 basic to	HOLE LIMITS									
	A12 [2]		B11 [2]		C11 [2]		D11 [2]		H11	
- 24	+ 33	+ 69	+ 20	+ 44	+ 13	+ 36	+ 8	+ 31	0	+24
- 30	+ 51	+ 98	+ 31	+ 61	+ 19	+ 48	+ 12	+ 41	0	+30
- 35	+ 71	+ 130	+ 41	+ 77	+ 26	+ 61	+ 16	+ 51	0	+35
- 43	+ 91	+ 161	+ 55	+ 98	+ 33	+ 77	+ 20	+ 63	0	+43
- 51	+ 122	+ 205	+ 71	+ 122	+ 41	+ 93	+ 26	+ 77	0	+51
- 63	+ 157	+ 256	+ 91	+ 154	+ 53	+ 116	+ 31	+ 94	0	+63
- 75	+ 197	+ 315	+ 114	+ 189	+ 69	+ 144	+ 39	+ 114	0	+75
- 87	+ 252	+ 390	+ 142	+ 228	+ 83	+ 169	+ 47	+ 134	0	+87
- 98	+ 307	+ 465	+ 173	+ 272	+ 98	+ 197	+ 57	+ 156	0	+98

1- The subranges include the high limiting figure, thus: From above 0.04 inch to 1/8 inch, inclusive, and so on

2- Tentative value

number of specific fits most commonly required in manufacturing practice.

Since the ASA committee is interested primarily in fits, the present article deals exclusively with holes and shafts meant for this purpose, and not with parts having tolerance grades IT 12 to IT 16.

Recommended ISA Fits

These fits are given in Tables I and II for the basic hole and the basic shaft system, respectively. In the original tables, the limits, or rather the permissible variations from nominal size, are given in microns (one micron equals with close approximation 0.00004 in.). In Tables I and II, these values have been converted to ten thousandths of an inch (tenths). Values up to 10 microns have been rounded to the nearest half tenth and larger micron values to the nearest tenth. The nine subdivisions of the range of nominal diameters given in the extreme left-hand column have also been rounded. For example, the diameter 10 mm., which is very close to $\frac{13}{32}$ in., has been rounded to $\frac{3}{8}$ in. The purpose of this rounding is greater simplicity in the presentation of the data. However, if American industry decides to adopt the ISA system, it may be necessary slightly to adjust some of the values given here in order to obtain the complete practical interchangeability of fits which is the ultimate purpose of an internationally unified system. In the meantime, the minor variations caused by the rounding applied in Tables I and II affect in no way the question as to whether the nature and variety of the recommended ISA fits answer the general requirements of the industry in this country.

Permissible Wear for Gages

For each grade of tolerance to be given on the product, the ISA system specifies the grade of tolerance and the permissible wear for the gages to be used in checking this product. For example, if the two parts have a tolerance of the grade IT 7, the plug and snap gages should have a tolerance of the grade IT 3.

Numerical values of ISA gage tolerances and permissible wear will not be given here, but a few words may be said about a matter of principle concerning the way in which they were determined. In the ISA system, the tolerance on the "not-go" gage is equally divided on the plus and the minus side. The tolerance on the "go" gage lines within the limits for the product, but the gage is permitted to wear slightly past the "go" limit. Therefore, the actual size of an accepted workpiece may slightly exceed either of its nominal limits. This chance is small, and the ISA committee, therefore, believes that the risk of getting a bad fit on this account may be disregarded. Furthermore, the ISA committee has considered the fact that progress in the manufacture of gages leads to a decrease of the smallest practicable gage tolerances and to less gage wear for a given number of inspections (harder gage metals). Hence, in the course of time, the variation in the limits, between which the workpieces are actually held, is bound to decrease.

In the United States, a peculiar situation now exists in this respect. The American tentative standard of 1925 explicitly states: "The extreme sizes for all plain limit gages shall not exceed the extreme limits of the part to be gaged." In other words, all gage variations must remain within the nominal limits of the workpiece. However, it is not uncommon for gage manufacturers in this country to divide the tolerance on the "not-go" gage equally on both sides of the nominal limit. While contrary to the American tentative standard, this practice is the same as that proposed in the ISA system. Its purpose is obviously to reduce as much as possible the encroachment on the product tolerance.

Significance of Present Revision

Nationally, as well as internationally, the question as to what the next American standard for fits should be, is highly important.

If the United States, and in the course of time also Great Britain, should adopt the ISA system, world uniformity in the matter of cylindrical fits would be practically assured.[5] Once attained, this uniformity will probably become permanent, even though periodical changes may be required due to progress in technical production methods. This progress is bound to develop along the same lines in all major industrial countries.

On the other hand, if American industry, in devising its tentative standard of 1925, prefers to adopt a system different from the ISA proposal, the chance for ultimate international agreement will probably become small, in fact, it may be expected that, say within the next ten years, the new American standard—whatever this may be—will become widely introduced into practice in this country because of the growing need for a system of fits in many branches of industry that so far have not paid any particular attention to this problem. Likewise, the ISA system promises to become firmly rooted on the European continent. France and Germany have already adopted and published the first part of the ISA proposal (briefly discussed here) as their national standards and several other countries are expected to follow in the near future. If ten years from now, the fit systems commonly used in the U. S. and Europe differ to any considerable extent, it will be difficult, if not impracticable, to reach a compromise between them, even though by that time international unification may appear to be more desirable than ever before. For this reason, the decision which American industry must take in this matter should be weighed with the greatest care.

[4]Applying the ratio 1.6 in stepping down from IT 6 to IT 5 would have given the latter grade a value of 6.4*i*, instead of 7*i*. However, the value 7*i* was considered to be the smallest shaft tolerance that can generally be maintained with present production equipment.

[5]No forecast about the attitude of British industry can be made, but it is interesting to note that the British have adopted 68 F as their national standard reference temperature for gages (instead of 62 F) for the sake of international uniformity.

Shall We Flame-Cut Steel?

Flame cutting of metals has caused many heated discussions, the temperature sometimes approaching that of the flame itself. Opinions have varied from opposing the process entirely to advocating it for all sorts of work. It is admitted that the cutting flame heats the steel next to the kerf well above the critical range. Just how far or what the effect is is a point in dispute. Some tests indicate that on low carbon steel of 0.30 per cent, the metal next to the cut is actually refined by the heat and is stronger and harder than before cutting. These steels are usually cut when cold, although some recommended preheating, as with high carbon and alloy steels. Preheating also retards the cooling and tends to prevent the tendency to crack that might otherwise result. Before you decide not to flame-cut a piece where it will save a lot of money, it will pay to get all the information available from those who know.

Too Much Economy

Economy in little things is a good thing if we don't carry it too far. Brazing or welding tips of T-C or high speed steel on low cost shanks has advantages. But when it comes to brazing high speed tips on the end of $\frac{3}{8}$ in. carbon steel tool bits it may be carrying economy a bit too far. It may be like paying a watchmaker two dollars to repair a dollar watch.

Efficient Air Brake Repairs

FRED H. COLVIN
Editor, American Machinist

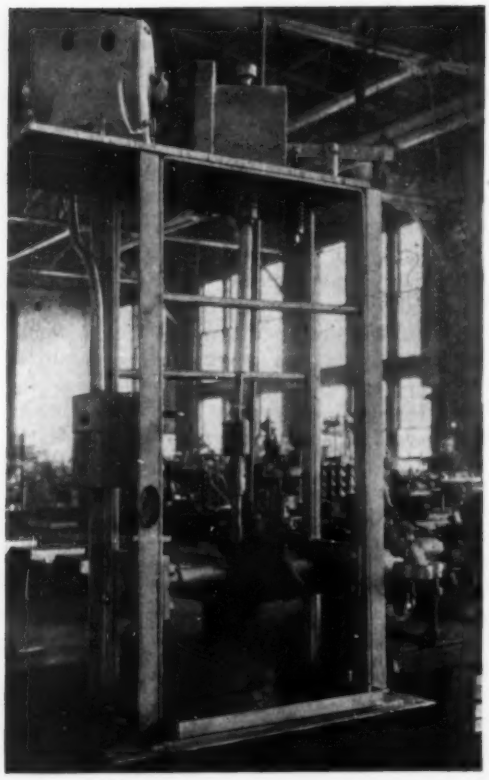


Fig. 1—Repairs begin with dis- this framework. An air-operated assembling the triple valves in vise holding the body of the valve while the bolts are removed by the vertical motor-driven shaft

Fig. 2—Valve bodies and parts are placed in metal trays and roll along the conveyor to the different men who make repairs. Standard gages are in the case shown

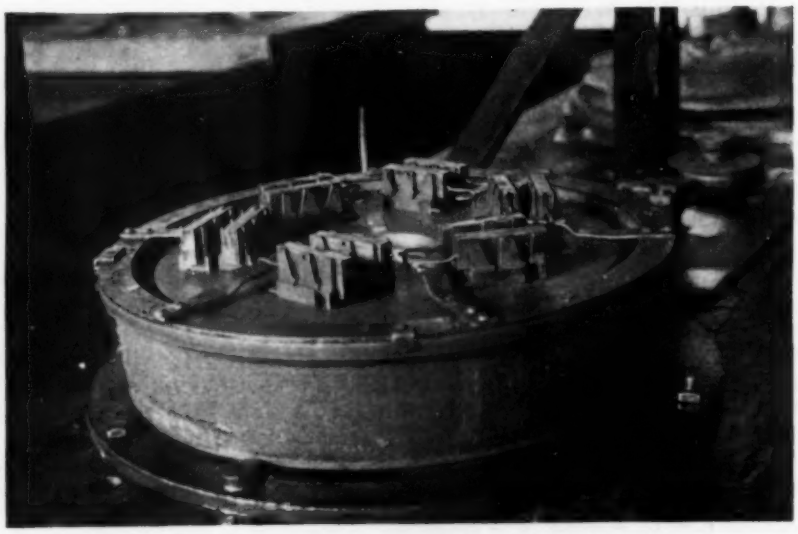


Fig. 3—Lapping disk for surfacing the small slide valves. Weights in the valve exert all necessary pressure. Wire hooks hold the valves against rotation

EFFICIENT handling of air brake equipment is vital on any railway. When the number of units to be handled runs into the thousands, both time and cost are particularly important. This article shows some of the methods used in one of the shops of the Pennsylvania Railroad, for handling triple valves systematically and with excellent results.

At one corner of the department is the framework seen in Fig. 1. This framework supports a motor and suitable gearing on top, and from this driving unit the telescoping shaft extends down to the operator. The lower end of the shaft is fitted to take wrenches of any size needed to remove or replace any bolt, nut or capscrew used in the valve. With the valve held as shown it is an easy matter to remove the cover bolts in short order. A collar is left free on the shaft and allows the operator to hold it and move it from bolt to bolt without stopping the shaft. When not in use the collar is supported on a hook, out of the way. The valve is held by an air-operated vise, controlled by a valve at the right.

With the bolts removed the valve

goes to the bench at the right and is taken apart. The parts are put in metal trays, some of which can be seen under the bench in Figs. 1 and 2, and also on the small roller conveyors that carry them away from the bench. In Fig. 2 can also be seen a set of gages by which the various parts of the valve are checked for wear. Two trays, each with a completely disassembled valve, are also seen at *A*, Fig. 2, ready to start down the conveyor on their way to the repair men in the department.

One of the important parts of the triple-valve mechanism is the brass slide valve which controls the passage of air in different ports, so as to perform different functions. To secure valve seats that are both flat and smooth, these seats are lapped as shown in Fig. 3. The lap revolves inside a cast-iron case which carries six arms pointing inward. These are to hold the work being lapped. Between the prongs on each side of the valve is a block with a wire that hooks over one of the radial arms on the case. With the lap turning counterclockwise the wires on these blocks hold the valve in place and also supply a light but uniform pressure on the valve against the lap. This lap makes it possible to vary the number of valves being lapped within rather wide limits and has been found very satisfactory.

As the accuracy of the work depends largely on keeping the laps themselves flat and in good condition the lap-correcting device, Fig. 4, is part of the apparatus. Laps are periodically corrected by running them in contact with a master lap, as in Fig. 4. Here the work-lap is revolved by the short crank arm over the master lap beneath.

In order to lift the work-lap easily the shaft with the cam controls the amount of movement this being easily varied from merely relieving pressure to lifting it to the limit of the frame.

The lapping of the valve to its seat is done in a machine where a large number of valves can be handled at once. A small section of this machine is shown in Fig. 5. Each valve body is located on one of the round tables at the right. A slide valve is hooked to each of the hanging arms, after which the machine moves them vertically until they have been lapped to a good bearing.

The gaging of the worn parts of the triple valves with standard gages adopted to meet the views of the Bureau of Safety, Interstate Commerce Commission, has been made mandatory by the American Railway Association.

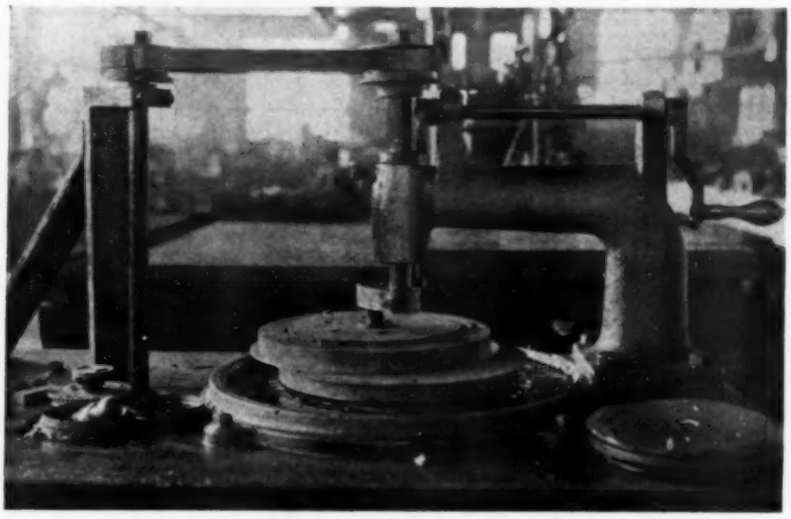


Fig. 4—Special machine for keeping laps true. The work lap on top is revolved by a crank and passes completely over the master lap below

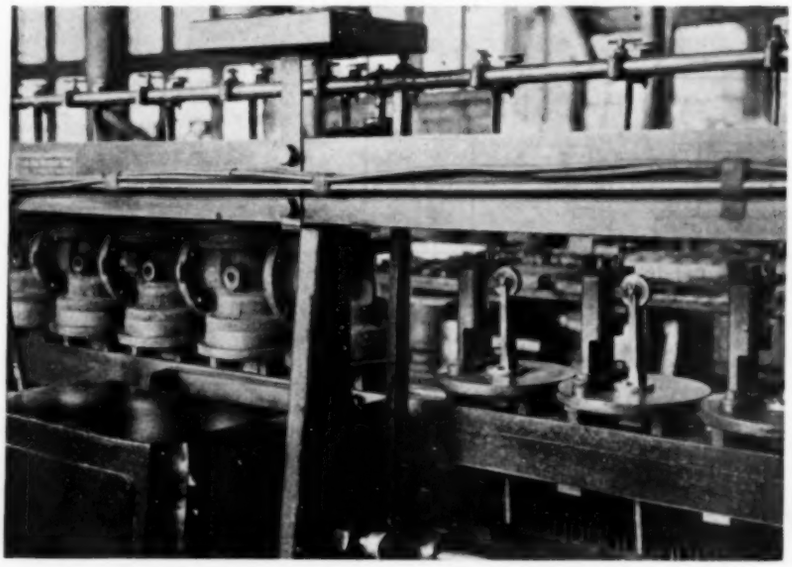


Fig. 5—Slide valves are lapped to their seats on this special machine which handles about a dozen at once. Valves are in place at left while the right-hand view shows how they are held

Milling Helical Grooves in Long Shafts—Discussion

JOHN E. HYLER

In an article under the title given above (*AM*—Vol. 78, page 258), Emil Wittmann describes a process that is very interesting, and one that without doubt is very valuable in many cases. It does not, however, as I am sure Mr. Wittmann is well aware, offer a means of maintaining very great accuracy in the cut produced. With reference to accuracy, something depends upon the condition of the cutter and also on that of the stock. If hard spots are encountered, or if the cutter shows a disposition to crowd for any reason whatever, the groove just cut will crowd one way or the other on the former pin, with consequent variations. Where accuracy is of great importance, as in cutting helical grooves in shafts to be reciprocated for cam actuation and for similar purposes, a more positive means is indicated. Where but a few such shafts must be accurately grooved, I believe that it is much better to fasten a small, flat bar of steel in a helix on the shaft to be grooved, drilling, tapping and using screws to fasten it as required by lead layout. This applied bar, which is milled on the under side to fit the shaft contour at the required lead, is then used to actuate a former guide of the straddle type.

In all other respects, the set-up will be quite like that described by Mr. Wittmann. While this method is more accurate, it is slower and leaves a series of screw holes in the shaft. However, these holes need not be large, and can be plugged if desired.

Press Tools for Making Bracket Plates

JOHN J. McHENRY

THE bracket plate, heavy lines, Fig. 1, presents an unusual case of forming and bending, in that it must fit accurately to the inner part of the conical shell indicated by dash-dot lines; the 0.465-in. hole must be located in the center line; and the vertical part must stand at 90 deg. to the center line and at the correct distance from the opening. The sequence of operations on such parts is always of interest to those engaged in press work. In this instance the plates were made in the three following operations:

1. Pierce all holes; extrude the metal around two holes to make walls for tapping with No. 10-32 tap; and cut off.

2. First-bend and first-form for body contour.

3. Finish-bend and restrike for body contour.

For the first operation, the tools illustrated in Fig. 2 were used. The die is in two parts, *A* and *B*. Part *A* required the slot *C* to be milled for clearance for the extruded metal around the holes. The stripper is 11 in. long and is also used as a stop for the stock. A support is riveted to its under side at *D* to prevent the stock from getting below and past the stop. A similar support is riveted to the entering side at *F* to aid in keeping the strip in line with the punches as it is fed over the die.

At *H* is the punch plate. While it is of the conventional design, the type of punches for piercing the two holes and forming the extruded walls around them may be new to many. The 0.105-in. teats on the punches pierce the holes and the 0.167-in. bodies extrude neat rings of reinforcement that are satisfactory for tapping. Punches of this type have been in use for a number of years. To those not familiar with them I can assure them that they give results that are entirely satisfactory. The cut-off punch is, of course, made to fit the die opening, but its face is machined through the center for $\frac{3}{16}$ in. below the outer edges, as shown in the view at the left. Since the outer edges serve as leaders or guides, permanence of alignment is insured.

The second operation is performed in the tools shown in Fig. 3. The die is composed of the four housing members *A*, *B*, *C*, and *D* and the forming pad *F*. The nest *H* and the locating pin *K* are used for locating the blank. The punch *L* is made in one piece. It will be noted that in these tools the flat bend from the vertical (see Fig. 1) is made and the required vertical and conical shapes are formed between the pad *F* and the punch *L*, the formed part being shown in the closed tools.

Pad *F* is actuated by a spring buffer

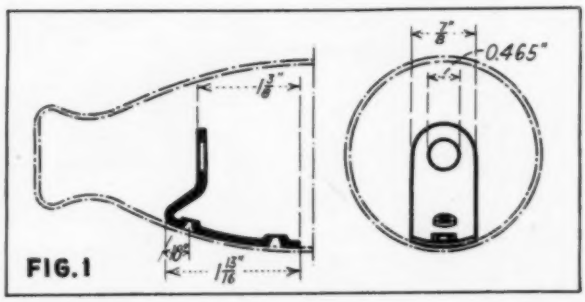


Fig. 1 — The bracket plate, shown in heavy lines, must fit the inside of the conical shell in line with the center

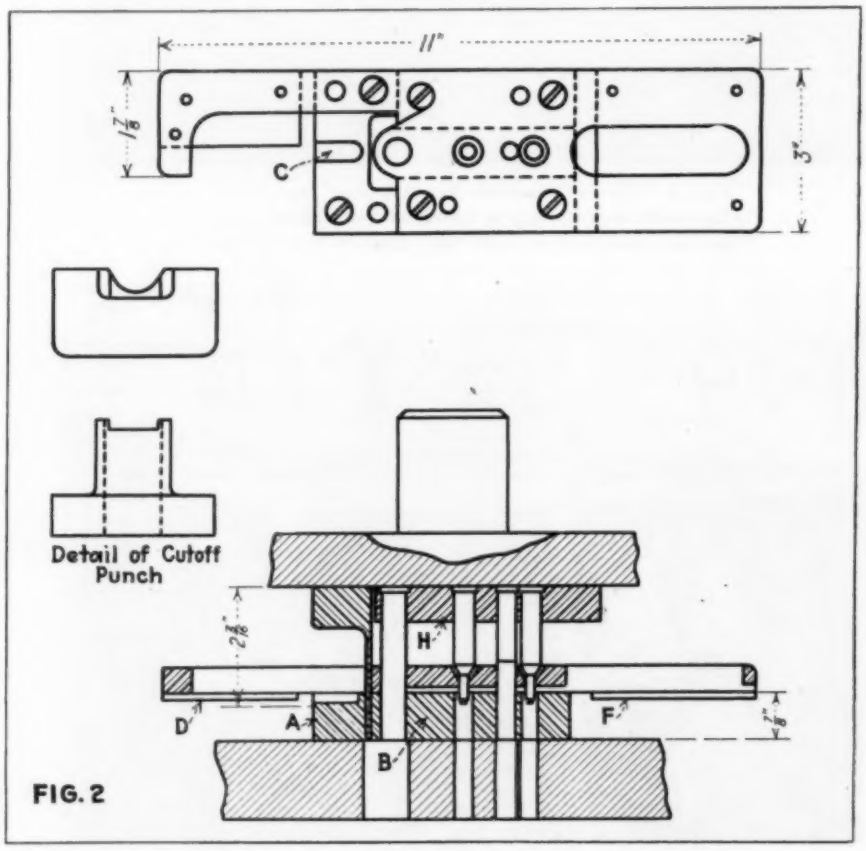


Fig. 2—In these tools all the holes are pierced, the metal around two of the holes is extruded to form walls for tapping, and the piece is cut off

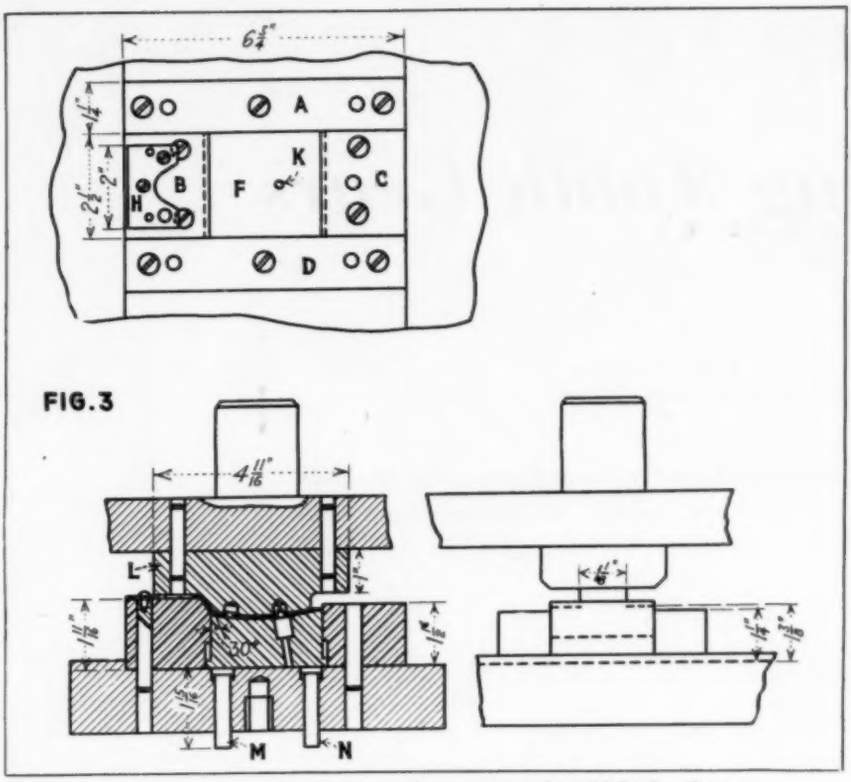


Fig. 3—Tools for the second operation, in which the first bending is performed and the work is first-formed for body contour

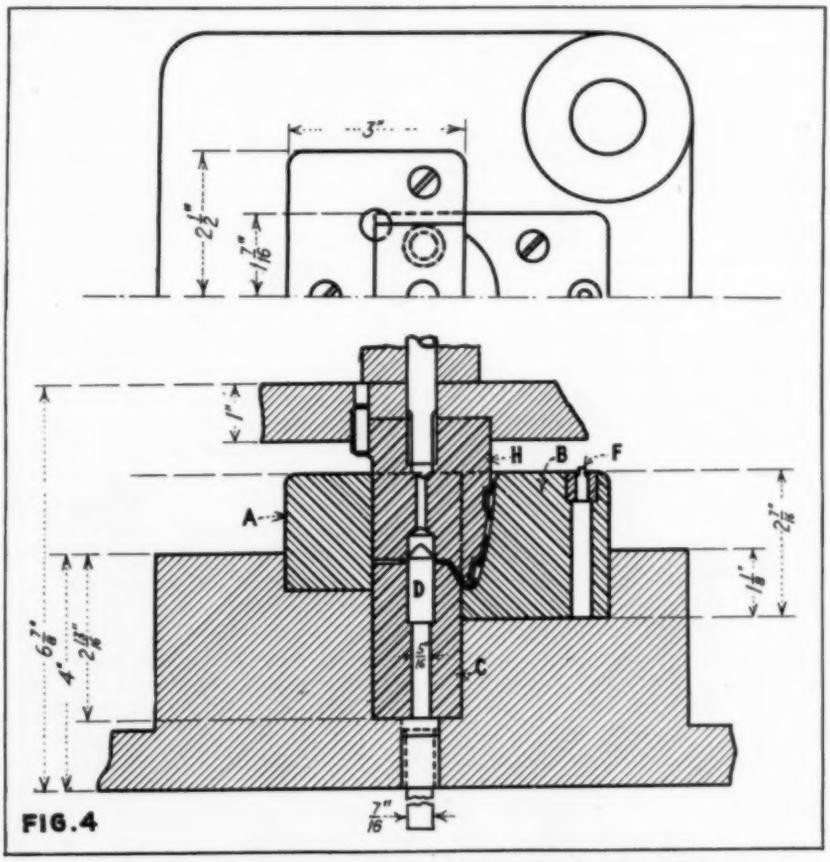


Fig. 4—Last-operation tools. Here the bracket plates receive their final bending and are restruck to form and set the body contour

attached below the die and acts upon the pressure pins *M* and *N*. In operation, with the tools open, the pad is in its uppermost position, and the operator locates the blank by nesting the rounded end in the nest *H*, locating one of the holes having extruded walls over the pin *K*. On the down stroke, the forming is done first, due to the stiff spring that actuates the buffer. The flat bend is then drawn over the 30-deg. angle as the pad descends. At the bottom of the stroke the pad bottoms, striking up the shape and setting it.

The final operation is performed in the tools illustrated in Fig. 4. The die is composed of the two members *A* and *B*, the pad *C*, and the two pilot pins *D* and *F*. The punch *H* is in one piece and is turned to the correct contour, then the three sides and the bottom are machined as shown. The die member *B* is bored to the correct contour and is machined to make contact with the housing member *A*. The 1½ x 2½-in. opening is thus made, and in it the pad *C* operates and is controlled for location. The pad is operated by a rubber buffer, which actuates it by pressure on pins below. The formed piece is shown in the tools, the ram being at the bottom of its stroke.

The illustration shows the press to be at rest with the ram up. The pad is then in its uppermost position, which brings its top surface ⅜ in. above the top surface of the die. When in this position the operator locates the part to be formed on the pilots *D* and *F*. When the press is tripped, the punch contacts with and holds the part against the pad *C*. As the punch continues downward, making the bend over the die member *B*, the part leaves pilot *F*, and the final bending and restriking operation is completed at the bottom of the stroke.

Why Brakes Get Hot

Brakes are even more important than the motor in almost any self propelled vehicle. And do they do a lot of work? Here's what the Pierce-Arrow engineer tells us, "the braking system in a Pierce-Arrow car, operating as a heat wasting engine, has to work at the rate of over 1,200 hp., or almost seven times the hp. of the 12-cylinder engine that propels the car." Or, "the heat generated in bringing a large car to a dead stop from a speed of 85 m.p.h. would heat 100 nine-room houses for the time the brakes were applied." Or to put it in still another way, this heat would melt 7 pounds of cast iron. That's something to think about when you're trying to save a little on brake linings in having the old car "titrivated" to run again.

Selection of

Hunting Tooth Gears

A. D. FORBES
H. D. James & Associates, Consulting Engineers

In many applications it will be found desirable to avoid cyclical wear in gear sets by the use of ratios whereby each pinion tooth will successively engage each gear tooth

IN MANY applications, hunting tooth gears are highly desirable for reducing noise and making the wear more uniform. This is especially true in any case where the teeth are not cut with great accuracy. Punched gears, such as may be used in electric clocks, are one example of such inaccurate gears.

Hunting-tooth gears are ordinary gears with the numbers of teeth so chosen that every pinion tooth meshes with all the gear teeth rather than a certain few. For example, if a pinion with nine teeth meshes with a gear with 36 teeth, each of the nine pinion teeth will mesh with a certain four gear teeth and no others. For this reason the teeth may become worn in cycles, and more noise may be developed after such wear. If the gear has 37 teeth instead of 36, all of the pinion teeth will then mesh with each of the gear teeth, the wear will be more uniform, and certain noise will not be developed. Analysis shows that the reason the first gears were not hunting-tooth gears is because the number of gear teeth and the number of pinion teeth had common factors while in the second case they did not.

Diagram Shows Principle

Fig. 1 shows diagrammatically how a given pinion tooth always comes between five and only five pairs of teeth on the associated gear for a gear having 30 teeth and a pinion having six teeth. In the case of a 20:6 ratio, as shown in Fig. 2, each pinion tooth is able to mesh with every other pair of teeth, but as it does not mesh with every possible pair of teeth, they are still not hunting-tooth gears. Fig. 3 shows a 25:6 ratio, in which every pinion tooth meshes with every pair of gear teeth by the time the gear has made six revolutions.

Exact Ratio Needed

In most cases, there is no difficulty in choosing hunting-tooth gears. However, in certain applications, such as the electric clock, exact and definite speed ratios must be used and the choice is more difficult. It would not do to have the second hand of the clock run at 1.0001 r.p.m. when the motor was running at its synchronous speed, say 900.0000 r.p.m. just for the sake of being able to use hunting-tooth gears. Because of the difficulty of choosing such gears properly they are often not used. The procedure outlined in the following reduces this difficulty to a minimum, and yet all the possibilities can be found if desired.

Let it be assumed that the driver is a high speed machine and that the final speed is to be low; if the opposite is true then the gear train only need be inverted after the design has been made. Let the high speed be x and the low speed be y. Then the speed reduction ratio is x/y.

The first step in the procedure is to reduce this ratio x/y so far as possible by dividing out common factors of x and y. Let this reduced ratio be a/b.

Now factor both a and b into their prime factors. Fractional factors are not used because fractional teeth are impossible; but by factoring as far as prime factors, all of the possibilities can be found.

The next step is to decide on the number of speed reductions to be used between the initial and final speeds. Let this number be c which will be governed by practical considerations. In general it will be large if the ratio x/y is large. Sometimes two or more values of c will be feasible.

Next determine arbitrarily how many teeth are to be used on each of the c different pinions, observing the following conditions:

A. The number b must be divisible into the product of these c different pinion teeth numbers;

B. These numbers of pinion teeth must have no common factors (except that one set of the factors of the number b is permissible as common factors).

Pinions Are Selected

The first condition must be satisfied in order that the number b will appear as the smaller number of the over-all speed ratio when all of the individual speed ratios are multiplied together. The second condition must be satisfied to make possible a hunting-tooth design. This choice of pinions is not as wide as it might at first seem. The lower limit to the number of teeth is determined by the number of teeth which it is physically possible to cut on a pinion. The upper figure is limited by the size of the pinions and even more by the size of the associated gear. If the pinion has a large number of teeth, its gear will have to have an enormous number of teeth to make much progress towards getting the speed reduced. Certain pinions may be standard parts, and the use of these may also influence the choice of pinions. In addition to these conditions it may be found that, with certain pinions, later parts of the process are impossible.

Factor these pinion tooth numbers into their prime factors, and place all of these factors in a group with the factors of a. Then eliminate from the group enough factors to make the number b. The factors now left are the

factors of all of the gear tooth numbers, and it is now necessary to assign them to the gears to mesh with definite pinions.

Separate these factors into c smaller groups, assigning one group to each of the pinions previously chosen but observing the condition that there are no common factors between a group and its corresponding pinion. Should this process prove impossible or if the results are impractical it will be necessary to go back and reassign the pinions. By noting the source of the troublesome factors, proper pinions can soon be found.

The various possibilities can be found by assigning the factors to the pinions in all possible ways, still observing the conditions and by choosing various pinions and repeating the process. In some cases, the number of possibilities will be extremely large; in such a case a combination which is suitable can be easily selected. In other cases, the number of possibilities is small, but all of the possibilities can then soon be tabulated and the most desirable chosen.

Steps May Be Equalized

Although this is not a necessary condition, the design will probably be found more satisfactory if the individual speed reduction ratios are about equal. By multiplying each pinion number by the c^{th} root of the ratio a/b, the approximate number of teeth can be found for the corresponding gear to make the ratios equal, and the factors can be assigned to obtain approximately this number.

To summarize:

1. Assume the ratio of initial and final speeds to be a/b where a is greater than b and where the ratio a/b has been reduced so that a and b have no common factors;

2. Factor a into prime factors;

3. Factor b into prime factors;

4 Choose the number of speed reductions to be used and let it equal c;

5. Arbitrarily select the number of teeth to be used on the c different pinions so that:

A. The number b is divisible into the product of these numbers;

B. The pinions have no common factors (except perhaps the factors of b);

6. Factor each of these pinion numbers into prime factors;

7. Place all of the pinion tooth factors in a group with the factors of a;

8. Eliminate from this group enough factors to make up the number b;

9. Separate the remaining factors into c smaller groups, assigning one group to each pinion and choosing the groups in such a way that there are

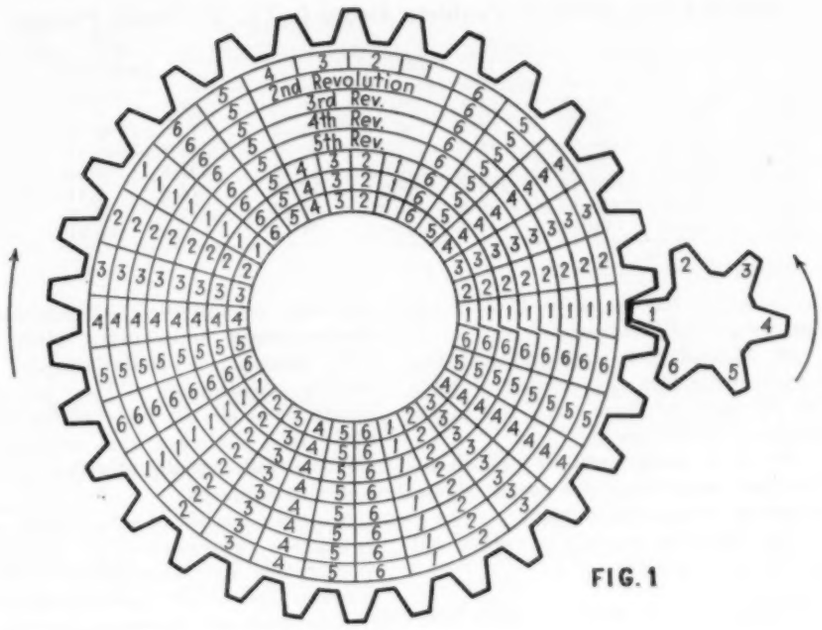


FIG. 1

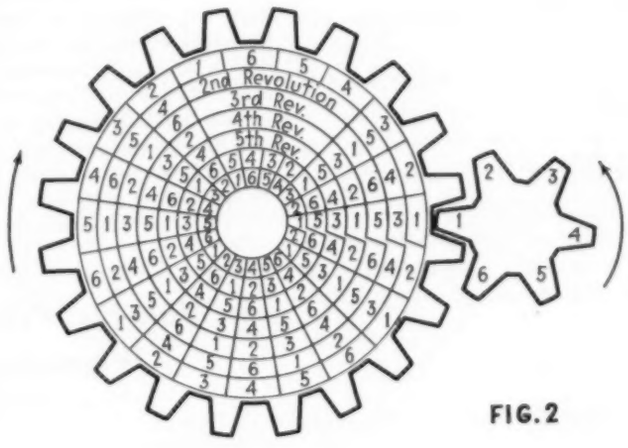


FIG. 2

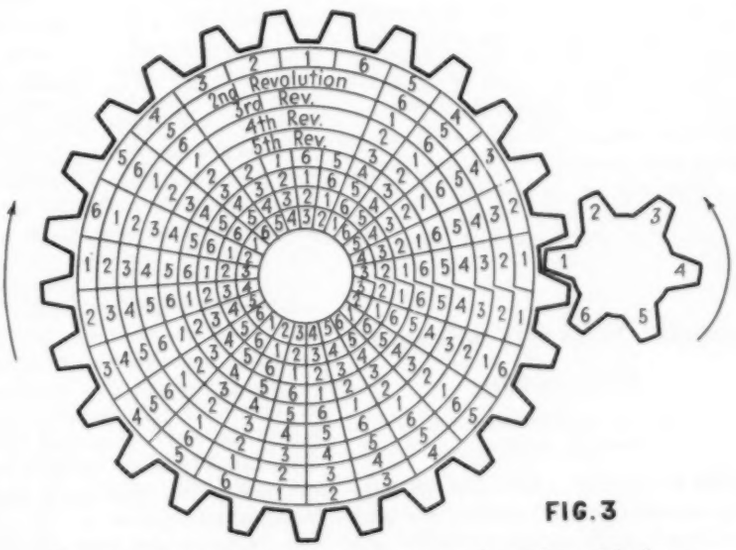


FIG. 3

Fig. 1—With a 30:6 ratio each gear tooth meshes with the same pinion tooth every revolution. Fig. 2—With a 20:6 ratio each pinion tooth meshes with a greater number of teeth but not with every gear tooth. Fig. 3—A 25:6 ratio has no common factor; the hunting tooth principle applies

Solutions to 2800:18 Problem Using 6, 11, 15 Tooth Pinions

Desirable			Undesirable			Impossible		
35:6,	100:11,	44:15	25:6,	35:11,	176:15	125:6,	2:11,	616:15
35:6,	50:11,	88:15	25:6,	140:11,	44:15	77:6,	1000:11,	2:15
55:6,	50:11,	56:15	55:6,	175:11,	16:15	55:6,	1400:11,	2:15
55:6,	100:11,	28:15	77:6,	125:11,	16:15	9625:6,	8:11,	2:15
25:6,	80:11,	77:15	125:6,	28:11,	44:15	1375:6,	2:11,	56:15
25:6,	40:11,	154:15	35:6,	200:11,	22:15	875:6,	2:11,	88:15
25:6,	70:11,	88:15	125:6,	16:11,	77:15	385:6,	200:11,	2:15

no common factors between a pinion and its group of factors;

10. Multiply out each group of factors to determine the number of teeth on the gear to mesh with the pinion assigned to that group;

11. As a check, multiply out all individual ratios and the result should equal the original ratio a/b.

The following example is worked out on the above outline:

Problem: higher speed = 2800, lower speed = 18

1. $\frac{2800}{18} = \frac{1400}{9}$; $a = 1400$; $b = 9$
2. $1400 = 2 \times 2 \times 2 \times 5 \times 5 \times 7$
3. $9 = 3 \times 3$
4. Let $c = 3$
5. 6, 11, and 15 tooth pinions
6. $6 = 2 \times 3$
   $11 = 11$
   $15 = 3 \times 5$
7. 2-2-2-2-3-3-5-5-5-7-11
8. 2-2-2-2-5-5-5-7-11 (3-3-eliminated)
9. $\frac{5 \times 7}{6} \quad \frac{2 \times 5 \times 5}{11} \quad \frac{2 \times 2 \times 2 \times 11}{15}$
10. 35:6 50:11 88:15
11. $\frac{35}{6} \times \frac{50}{11} \times \frac{88}{15} = \frac{1400}{9} = \frac{2800}{18}$

This is only one solution to this problem; the accompanying table shows some of the other solutions using these same pinions. Only a few of the possibilities are listed as there are some 80 theoretical solutions. The greater share of these would not normally be carried through to final solution, however, as they would be recognized as impossible to construct or undesirable because of the magnitude of the individual reduction ratios.

Johnson Tells His Salesman

Discussion

W. R. NEEDHAM
Stafford, England

John R. Godfrey, (*AM*—Vol. 78, page 188), as usual has very pertinent advice to deliver. His goods generally get across.

It is undoubtedly up to design and manufacturer to acquaint the salesman with the real facts. In so exacting a business as the various branches of engineering, an *informed* salesmanship is of the utmost importance. Mere surface glibness, a facile tongue, are entirely inadequate. The salesman should have all the facts at his finger tips. It is necessary that he shall be able to talk intelligently as an engineer to engineers.

A certain amount of actual design and production experience is an invaluable qualification for salesmanship. Where the man "out to sell" has the advantage of this practical experience, he will be able to show the prospective purchaser how due attention to legitimate manufacturing economies reduces costs without in any way impairing intrinsic excellence or service requirements. While he will and must—give courteous attention to customer preferences, he will be in excellent case to show the advantage of alternative proposals, especially when the customer gains the benefit.

A Sine-Bar Protractor

Discussion

WILLIAM S. ROWELL

We should all thank C. W. Putnam for his description of his sine-bar protractor (*AM*—Vol. 77, page 747). Its convenience over the usual sine-bar practice is obvious. But two questions arise; (a) What will it cost; and (b) How accurate will it be? If you make it yourself it may cost anything you are willing to let it cost. My feeling is that if any reputable toolmaker were to bid on such an instrument, to be made from Mr. Putnam's drawing, using appropriate materials and up-to-date methods, the bid would be in three figures to the left of the decimal, with the left-hand figure several removes from unity.

The answer to the second question would depend quite largely on how accurately the instrument had been made. A glance is sufficient to show exceptionable difficulties. Buttons C and D must be accurately placed 45 deg. apart on a 2-in. radius. Also their relation to the position of the blade must be very exact, and their relation to the bottom of the base must be equally exact.

Assuming the impossible—that the instrument is perfect, we must still have a perfect micrometer and be able to use both it and the protractor with exceptional nicety and skill in order to be able to measure an angle to even 10 sec. But if we could use this instrument and Mr. Putnam's table of sines to obtain measurements of 10 sec. between 0 deg. and 1 deg., we would often need quite a different method to secure such refinement between 44 deg. and 45 deg., because the sine of 44 deg. 59 min. 59 sec., obtained by interpolation is 0.7071033717, and the same function obtained from Mr. Putnam's table is:

(a) Sine 44 deg. 59 min. 0 sec	0.7069011
Sine 0 deg. 0 min. 59 sec.	0.00028604
Result (a)	0.70718714
Result (b)	0.70710195
Difference	0.00008519
(b) Sine 45 deg. 0 min. 0 sec.	0.7071068
Sine 0 deg. 0 min. 1 sec.	0.00000484817
	0.70710195183

This difference between sines obtained by interpolation and those in Mr. Putnam's table is because the table is based on the sine of 1 sec., between 0 deg. and 1 deg. Consequently it is in error, plus, for any greater angle. If, in seeking the sine of 44 deg. 59 min. 59 sec., we take from a seven-place table of sines the sine of 45 deg. and subtract 1/60 the difference between that and the sine of 44 deg. 59 min. 0 sec., we have followed regular practice and will obtain the results given. But if we subtract the sine of 1 sec. at 0 deg., we have subtracted too much. The increase of sine for unit increase in angle becomes less and less, until at 90 deg. it disappears. While the sine of 1 sec. at 0 deg. to 0 deg. 1 min. is very nearly 0.0000048482, the sine of 1 sec. at 44 deg. 59 min. 59 sec. is about 0.00000343. This shows that the table of sines of seconds should not be used for multiples of a second, except on angles of 1 deg. or less.

The difference between results obtained by (a) and (b) are similarly accounted for. In method (a) the sine of 59 sec. (as per Mr. Putnam's table) is added to the sine of 44 deg. 59 min. and the result is too large because this oversize sine has been added 59 times. In method (b) this oversize sine is subtracted from the sine of 45 deg. and the result is slightly minus. With nothing more refined than a commercial micrometer as a measuring instrument, hunting for seconds of arc on such a short radius is working in the region of great uncertainty. Generally speaking, "It is to laugh."

EDITORIALS

VOLUME 78 **AMERICAN MACHINIST** NUMBER 12

ESTABLISHED 1877

MCGRAW-HILL PUBLISHING COMPANY, INC.

K. H. CONDIT F. H. COLVIN

EDITORS

Durable Goods Report

EXCEEDING the fondest hopes of its organizers, the Durable Goods Industries Committee, in its three months of existence, has made an enviable record. It has placed before the Administration, and before the country, the case for the durable goods industries, which has long been needed. Its report has just been released after having been presented to the President some days ago. In this report, as published, are various letters to the President, to General Johnson and to interested code authorities on related subjects, but the body of the document is the most significant contribution to current economic thought. We wish it were possible to reproduce this report as we did the Committee's statement on General Johnson's twelve points, but it is too long. The conclusions, however, will be set down in the hope that they will lead those interested to secure a copy of the report from the Committee.

It is hard to see how a better statement of the recovery problem could be formulated than this, from Part I of the report:

"The key log in the problem is the unemployment in the durable goods industries, and more specifically, in the construction industries.

"Reduction in maximum hours has already been carried to or possibly beyond the economic limit in the durable goods industries under present conditions, and further reduction will not materially contribute to the reduction of unemployment.

"The durable goods industries, by reason of their present financial situation and the nature of their business, are unable to absorb additional employees or increased production costs until the sales volume of their products is expanded.

"These industries cannot hope for substantial increase in their sales volume until there is such further restoration of confidence in the economic future as will encourage the use, by private investors, of the available supply of capital and credit."

Pointing out that since most of the unemployment is in the durable goods industries the natural place to find the remedy is in those industries, the Committee concludes at the end of Part II:

"Some of the fundamentals of recovery have been accomplished and the way is now open to achieve a steady and reasonably rapid improvement.

"Government can accelerate the process, particularly in the way of authorizing needed private credit facilities and removing unnecessary credit deterrents.

"Government can do no one thing as important as to encourage a widespread public confidence by exhibiting its own firm faith in recovery and by refusing to countenance measures that are inconsistent with our existing economic system."

As its immediate remedy for unemployment the Committee proposes a modernizing campaign of national scope to include homes, business buildings, factory and power-plant equipment, public works and equipment, farm equipment and railways. It would also stimulate activity in new construction and recommends an effort "to stabilize at fair prices building materials, building labor, furnishings and equipment through local agreements."

Looking further ahead, the Committee suggests as remedies for permanent unemployment the development of subsistence farming, the concentration of public works construction in times of depression, town planning and city rehabilitation, reforestation by a Civilian Construction Corps fluctuating in size to meet emergency employment needs.

The Committee deserves unstinted praise for its success in combining economic soundness, practical business judgment and a broad social outlook in a single document. We commend a careful study of it to every member of the Administration and of Congress, and to those in the durable goods industries as well.

Machine Finishes

IF THERE is anything more indefinite in a contract than "the work shall have a first-class finish," it slips our mind at the moment. Yet this clause or a similar one, can be found in many specifications. It is to eliminate this vague and all but meaningless wording that the A.S.M.E. Sectional Committee on Standardization of Classifications and Designation of Surface Qualities has been hard at work. We are glad to be able to report that real progress is being made by the experienced and thoroughly practical engineers who are on the committee. The work of the committee has been divided into classifying the finishes produced by abrasives and by cutting tools.

In spite of the difficulties involved, and they are many, there is good reason to believe that very practical results will be forthcoming. Quality of finish has been hitherto almost entirely a matter of personal, visual judgment. Means are being devised, however, for actually measuring the kind of finish by comparative methods. Several well known firms have already established standards to classify standard finishes, emphasizing the recognized need for such standards.

When we can specify the finish desired by name or number, and get it with the same certainty that we now get a Class 2 fit in screw threads, both contractors and customers will have fewer occasions for misunderstandings and for the picturesque language that frequently accompanies them.

Open Prices

AS HERMAN LIND pointed out in his excellent address in Washington, with open prices the purchasing agent "can direct his efforts to determining the real value of the product in proportion to the price offered instead of chiseling between hungry competitors." This reminds us of the statement of the well known P.A. of a very large concern. He had just given an order at the price asked because he knew from previous experience that this tool builder had but one price. He said: "If all builders were like you my job would be easy. I know you have one price to everyone. Now I've got to spend at least an hour getting another builder down to what I know is his real price. He seems to think I enjoy beating him down. I don't. But it's my job to buy what we need at as low a price as anyone else gets. It usually takes him an hour to make up his mind to tell me the real price."

.CHIPS.

Washington—House passes loans-to-industry bill with amendment to take care of public school teachers . . . Darrow report and NRA reply bring exchange of compliments between Darrow, Johnson and Richberg, after which Johnson takes Darrow for a ride—to Mt. Vernon . . . House adds rider to bank deposit insurance renewal bill providing for pay-off of depositors in closed banks . . . Wagner Industrial Disputes Bill, somewhat softened, is reported out under pressure by Senate Committee . . . Roosevelt, by executive order, authorizes Johnson to abandon price fixing and fair trade practices for service industries but permits local groups to set up their own arrangements.

Foreign—Bulgaria has new government but keeps same king . . . Chinese report that Japanese bombing planes destroyed 20 villages and killed 1,000 farmers in Manchuria . . . Japanese upset by Swanson threat to extend U. S. naval bases in the East if treaty ratio is changed . . . Paraguay tells League of Nations it is going to get "mean" in Chaco war, scrap rules of international law . . . Germany's intellectuals ranked with "killjoys" because they have criticised Hitler regime . . . U. S. offers to reduce navy and join arms traffic control agreement in effort to save Geneva disarmament conference . . . Cubans threaten U. S. envoy and his chauffeur . . . Sale of munitions to Chaco belligerents banned by act of Congress.

Finance—Big silver speculators likely to cash in as result of Administration's silver policy even if 50 per cent excess profits tax is voted . . . Stock exchange control law vests control of margins in Federal Reserve and sets statutory limit . . . New commission, likely to be headed by Federal Trade Commissioner Landis, to be set up to administer the act . . . Sizable Treasury offer due shortly . . . Wall Street matches the drought on the prairies as stocks traded in a single day dry up to less than 380,000 shares . . . Philadelphia mint having trouble making quarters and pennies fast enough to meet demand.

Industry—Troops called out in Minneapolis and Toledo strikes as volunteer deputy is killed in Minneapolis and 1,500 men are besieged in Auto-Lite plant by 3,000 Toledo strike sympathizers . . . Minneapolis truckers' strike is settled after troops are called out but Auto-Lite plant is closed to prevent further bloodshed . . . Grace declares for open shop in steel industry as union leaders threaten strike of 100,000 men on or about June 10 . . . Oldsmobile output for 1934 to date exceeds total for 1933 . . . Railroad car orders ten times those of a year ago . . . Johnson yields on communications code which covers only labor provisions, but threatens to impose code on electric light and power industry . . . Weirton Steel wins first round in NRA battle as federal attorney's plea for temporary injunction to prevent company interference with labor representation vote is denied . . . Textile union heads threaten general strike if NRA order reducing production 25 per cent is carried out . . . Roosevelt approves steel code revised to add more basing points and to correct faults, and promises to provide machinery for employee elections.

Trade—Sears, Roebuck's May sales 30 per cent above sales for May, 1933 . . . After decreasing for three successive weeks freight car loadings turn upward again . . . Burlington Zephyr sets non-stop long-run record of nearly 80 miles per hour for Denver-Chicago run . . . 1934 Century of Progress opens in Chicago with bigger crowd than last year, better exhibits . . . Automobile companies start concentrated sales drives, General Motors opening simultaneous exhibits in 60 cities . . . Drought drives wheat and corn prices up sharply, wheat crossing one dollar.

Indicators—Fear of steel strike stimulates customer orders and activity rate rises to 59 per cent . . . Electric power production also up . . . *Business Week* index off nearly a point.

Machine Tool Builders Hold Largest Meeting

Marked by the largest individual attendance and by the greatest number of companies represented in the history of such gatherings the National Machine Tool Builders' Association met in Chicago, May 23-25. The first day of the convention was devoted to the meeting of the Machine Tool and Forging Machinery Industry under the chairmanship of Henry Buker, vice-president, Brown & Sharpe Mfg. Co., head of the Supervisory Agency of the industry code; the other two days to the association meeting.

Mr. Buker reported briefly on the activities of the Supervisory Agency and observed that the trade practices clauses of the code would give rise to nothing but satisfaction if everyone would take seriously the restriction against resorting to subterfuge. He was backed up on this point later in the meeting by W. A. Viall, vice-president, Brown & Sharpe Mfg. Co., who urged action in the spirit of the code regardless of personal opinions of NRA.

Addressed by Major Crom

R. E. Flanders, president, Jones & Lamson Machine Co., explained certain changes in the industry statistics and urged members to plot their own statistics against those of the industry. Chairman George H. Benzon, Jr., vice-president, Wm. Sellers & Co., of the Committee on Costs reported that no acceptable standard costing plan had been worked out. Major Wm. H. Crom, administration member of the Supervisory Agency, stated that the machine tool builders as a group are operating much more smoothly than most other industries are. He said further that unless they take an active part in framing the regulatory legislation that will follow NIRA they are likely to find themseves hampered by restrictions aimed to control the acts of the more recalcitrant groups. C. R. Messinger, president, Chain-Belt Co., and a member of the Durable Goods Industries Committee, explained what had been done by that body and paid high tribute to James W. Hook, president, Geometric Tool Co., for his part in writing the Committee's report to President Roosevelt.

In his brief opening remarks, President E. A. Muller of the Association commended the plan of former Ambassador Jas. W. Gerard for an investors' association to make vocal the opinions of the unorganized holders of securities who are the hope of American business and industry. Robert M. Gaylord, president, Ingersoll Milling Machine Co., advocated the continuation of united effort through the Machinery & Allied Products Industry in the interests of all builders of machinery. He outlined plans for the immediate future in much the same terms he used at the MAPI meeting the previous week (*AM*—Vol. 78, page 380c). He pointed out that MAPI speaks only for machinery builders and does not compete with the Chamber of Commerce of the United States nor the National Association of Manufacturers.

Company Unions Discussed

The address of C. S. Ching, director of industrial relations, U. S. Rubber Co., on "The Question of Company Unions," was the high point of the meeting. Those who heard it are still talking about it and will not soon forget it. Building his talk on experiences in plants of his own company during the past 15 years, Mr. Ching stressed the vital necessity of developing in employees a feeling that they are an important part of the company for which they work and that their opinions and suggestions are welcomed by the management. He warned against arbitrary and unexplained moves by management and remarked that the time-honored prerogative of firing a man without cause is rapidly becoming a thing of the past.

Dr. Willard L. Thorp, former director of the Bureau of Foreign and Domestic Commerce, the only speaker at the dinner, pointed out that only since the War have economists come to realize that industry cannot be treated as a homogeneous whole. Durable goods are the weak spot in the system of balances vital to economic health, and are now so recognized. We know now, for example, that doubling the number of locomotives or houses or machine tools built in a year will have little effect on price, because the number is relatively small compared with all the units in use, whereas for consumer goods the year's output determines the price.

Durable goods are bought largely in prosperous years, thus widening business cycle fluctuations, they are subject to obsolescence which is unpredictable and thus disturbing, and ordinary market forces are ineffective in maintaining stabilization. They are the unstable elements that upset the general economic equilibrium. Heretofore the growth in population, three to four per cent a year, has helped to absorb any excess production, but at the present rate we shall reach stabilization in 20 to 30 years, as many other countries have. Since durable goods are forming a growing proportion of our purchases wide fluctuations are inevitable unless we find new controls.

Herman H. Lind, general manager of the Association, climaxed his report of the constructive sales building activities of the year by reiterating his plea for the education of congressmen in the economics of the machinery industry. He suggested inviting them to visit plants of their constituents to get a first-hand picture of how machinery is built and sold. Other speakers were Frederick B. Heitkamp, sales manager, Cincinnati Milling Machine Co., who spoke on "Selling Technique;" Harry Tipper, executive vice-president, American Manufacturers' Export Association, whose subject was "The Future of Machine Tool Exports;" and Frederick V. Geier, president, Cincinnati Milling Machine Co., who warned of the danger that the Wagner Industrial Disputes Bill may be forced to passage, and urged those who opposed to wire Senator Walsh.

Three Subdivisions Added To MAPI

An amendment to the basic code for the machinery and allied products industry has been approved to permit the admission of three additional subdivisions. The newly created groups are those for the chemical engineering equipment industry, the electric overhead crane industry, and the locomotive appliance industry.

Bottlers to Hold Machinery Exhibits

Exhibits of machinery used by beverage manufacturers will be one of the outstanding displays at the Annual Convention and Exposition of the American Bottlers of Carbonated Beverages in the 106th Armory, Buffalo, N. Y., on November 12-16. Among the classes of machinery which will occupy large blocks of exhibit space are those for bottle washing, carbonating, crowning and filling, labeling and siphon filling. Twenty-three machinery manufacturers have already reserved space in the exhibit hall.

Business Leaders Look Ahead at Sloan Dinner

Progress in the next century was the central theme of the speeches at the big dinner given by President Alfred P. Sloan of the General Motors Corporation in the foyer of the corporation's building at the Chicago Century of Progress Exposition on the eve of the opening of the 1934 version of the Exposition. The remarks were a mixture of condemnation for that part of the New Deal which aims to freeze further scientific and mechanical progress and force us back into the old economy of scarcity, and expressions of optimism for the future when, as C. W. Nash, an unscheduled speaker, phrased it, "the people rise up in their might and stop it (the freezing process)."

Dr. Glen Frank, president of the University of Wisconsin, brought the 600 business and industrial leaders to their feet cheering when he climaxed his criticism of the New Deal in these words: "To restrict production and to raise prices as a general policy is to me not liberalism but reaction, not statesmanship but surrender, not creative advance but cowardly retreat. That way lies the subsidizing of inefficiency. That way lies the sabotage of superior management, which knows how to bring the cost of production and the price of products down. . . .

"The machine has not betrayed us. We have betrayed the machine. Science and technology have given us the means by which we may emancipate the race from poverty, drudgery and insecurity. If we now prove incapable of using these means to the full, the verdict of history upon us will be that we were a people strangled by our own success."

C. F. Kettering had this to offer: It is my impression that we are on the eve of things of an entirely different nature from the mere extension, refinement and development of the things we already know. Each year we discover new things which a short time ago we did not know existed. I cannot help but feel that we are about to break loose another great chunk of basic information which will keep us industrially busy for years to come.

"Most people think that science and industry are interested only in the development of labor-saving machinery. This is an entirely false notion. But we must not forget that for the last 50 years when the great program of building our railroads, cities and industrial plants was going on this labor saving was a most important thing, because we did not have enough people to do the work. We are all very much more interested in the production of labor producing projects and invention than we are in labor saving."

Harvey Wiley Corbett, architect, advocated mass production of homes to bring costs down and thereby speed up the capital goods industries. Dr. Morris Fishbein talked on medical progress, Dr. Arthur H. Compton on physics, Robert E. Wilson on chemistry, Carl Gray on streamlined trains, M. P. Aylesworth on broadcasting, and Dr. Walter B. Pitkin on how present practice will look 100 years from now.

Exports of Machinery During April, 1934

	April 1934	March 1934	April 1933
Electrical machinery and apparatus	$5,616,661	$5,593,785	$2,877,063
Power generating machinery (except automotive and electric)	487,761	400,933	239,578
Construction and conveying machinery	527,329	443,264	276,876
Mining, well and pumping machinery	1,582,840	1,717,902	801,005
Power-driven metal-working machinery	2,463,052	1,996,535	554,427
Other metal-working machinery	483,903	257,976	131,479
Textile machinery	561,402	682,485	330,432

Exports of Metal-Working Machinery During April, 1934

	April 1934	March 1934	April 1933
Engine lathes	$146,618	$94,770	$3,470
Turret lathes	54,286	28,393	6,407
Other lathes	54,367	49,702	279
Vertical boring mills and chucking machines	7,121	73,547	2,265
Thread-cutting and automatic screw machines	124,249	92,525	19,547
Knee and column type milling machines	100,044	67,882	200
Other milling machines	180,888	144,334	15,461
Gear cutting machines	177,400	181,330	25,236
Vertical drilling machines	219,545	47,310	5,801
Radial drilling machines	25,637	290	530
Other drilling machines	330,518	54,041	24,451
Planers and shapers	4,977	40,534	26,794
Surface grinding machines	20,668	16,605	650
External cylindrical grinding machines	60,206	151,039	1,034
Internal grinding machines	132,428	104,584	850
Tool grinding, cutter grinding, and universal grinding machines	73,251	29,942	5,152
Other metal-grinding machines	64,772	50,122	12,051
Sheet and plate metal-working machines	296,963	368,640	65,008
Forging machinery	75,083	25,103	18,839
Rolling mill machinery	78,329	26,103	17,565
Foundry and molding equipment	20,692	39,340	145,658
Other power-driven metal-working machinery and parts	215,010	308,399	157,179

Other Metal-Working Machinery

Pneumatic portable tools	86,965	41,849	27,736
Other portable and hand or foot operated metal-working machines and parts	59,649	50,128	22,876
Chucks for machine tools	7,404	10,980	4,077
Machine operated pipe and thread cutters, stocks, dies, taps & other machine-operated tools	315,989	134,622	49,195
Other metal-working machine tools	13,896	20,397	27,595

G. E. Elects Five New Vice-Presidents

At a meeting of the board of directors of the General Electric Co., on May 25, five vice-presidents were named as follows:

J. E. Kewley, of Cleveland, in general charge of the incandescent lamp division.

R. C. Muir, of Schenectady, in charge of the engineering department.

C. E. Tullar, of Schenectady, in charge of the patent department.

H. L. Andrews, of Erie, in charge of electrification of steam railroads.

E. O. Shreve, of Schenectady, in the commercial activities of the apparatus and supply business of the company.

K. M. Simpson Resigns from NRA

Last but two of the original NRA deputies and last of the four divisional administrators who put close to 1,000 codes through the mill, Kenneth M. Simpson left NRA as of June 1 to return to his profession of metallurgical engineer. W. Averill Harriman leaves his post as assistant administrator except for "two or three days a week" and may soon pass out of the picture also.

Another loss is W. H. Davis, New York patent lawyer, who brought as much order as was humanly possible out of the confusion of code enforcement. Another to leave the ranks is Dr. A. J. Hettinger, Jr., who returns to his investment business in Detroit. He will be remembered for his able presentation of the case for the rehabilitation of the capital goods industries at the code authority conference.

Dr. Murchison Made Director of Commerce Bureau

Dr. Claudius T. Murchison, North Carolina professor, has been named and confirmed as director of the Bureau of Foreign and Domestic Commerce. Backed by Senator Bailey his name went through the Senate without a ripple. None the less, his appointment upholds Assistant Secretary of Commerce John Dickinson in his demand that the bureau be freed from the menace of patronage.

Dr. Willard L. Thorp, former acting director, whose name the Senate refused to approve, is said to be in line for another important government appointment. The President voluntarily sent him one of his finest and friendliest letters when he left the bureau.

F. D. Hansen Made Member of Two Code Authorities

In accordance with recent announcement by National Recovery Administrator Hugh S. Johnson, Fred D. Hansen, general manager of the Federal Industrial Corporation, was made government member to the code authorities of the metal-treating industry and the marking device industry. Other newly appointed administration code authority representatives are as follows:

Power and gang lawn mower manufacturing industry and the advertising metal sign and display manufacturing industry—Charles A. Brantingham, of the Thompson & Lichtner Co., Inc., engineers.

Tool & implement manufacturing industry—A. A. Ainsworth, trade association executive and former general manager of the David Williams Companies.

Air valve industry and bottling machinery and equipment manufacturing industry—Francis E. Lee, director of the Colonial Trust Co.

Counter type ice cream freezer industry—D. J. Duncan, professor of marketing, Northwestern University.

Flexible insulation industry—Howard Berolzheimer, professor of finance, Northwestern University.

Chilled car wheel industry—J. M. Keller, manager of foundries of the American Car & Foundries Co., to take the place of C. A. Liddle, resigned.

Industrial safety equipment industry—D. V. Stratton, formerly general manager of the Fokker Aircraft Corporation and president of the Johnson Motor Co.

Shoe form industry—William H. Smith, Childs, Jeffries & Co.

Commercial fixture industry—David Newhall, formerly of the Bethlehem Steel Co. and the Motor Stoker Corporation.

Gas cock industry—A. J. Brandt, president of A. J. Brandt, Inc., consulting engineers.

Navy to Survey Yard Requirements

Present and future machine tool requirements of the navy yards in the continental United States are to be investigated during June by Lieutenant Commander R. J. Walker, in charge of the machinery section of the Navy Yards division of the Navy Department.

E. G. Herndon, civilian engineer in the Navy Yards division, is to accompany Commander Walker on the trip to all continental yards to pass upon tool requirements. The trip is expected to be completed by the end of June.

Because of economy cuts in the navy budget the original expenditure of $1,500,000 annually for machinery equipment in the navy yards has not been maintained. The present navy appropriation bill carries no allowance for replacements this coming year.

It is hoped, however, that next year Congress will be persuaded to appropriate sufficient funds to provide for replacement of machine tools which are badly worn, inaccurate, and require an excessive amount of labor to operate. If funds to be sought are appropriated, the machine tool industry will undoubtedly receive orders for $5,000,000 worth of equipment, according to navy estimates.

Lieutenant Commander DeWitt C. Redgrave, Jr., now in charge of the dry-dock at the Navy Yard at Longapo, P. I., has been ordered to Washington as an assistant to Commander Walker. He is expected to arrive here by the end of October after making a survey of the navy yards in the Islands.

B. F. Shepherd Nominated for A. S. M. Presidency

On May 24, at the Engineers' Club, New York City, the nominating committee of the American Society for Metals made the following recommendations for officers of the Society: for president, B. F. Shepherd, Ingersoll-Rand Co.; for vice-president, R. S. Archer, Republic Steel Corporation; for Secretary, W. H. Eisenman; for trustees, Walter Mathesius, Illinois Steel Co., G. B. Waterhouse, Massachusetts Institute of Technology.

• INDUSTRIAL REVIEW •

• With few exceptions the drought in the machinery business continues as unbroken as the drought on the prairies. Threats of strikes are still serving to keep prospective purchasers from acting, although the suppliers whose business is least affected by ups and downs in the automobile industry are doing better than those serving that mercurial activity.

• In the East some distributors report that May business was about on a par with that of April, others feel that everything is slowing down. Inquiries continue in fair volume. Pittsburgh agents believe that the decline in orders is likely to continue for some weeks because of the apathy that has overtaken so many possible customers. Inquiries are likewise fewer. In Cincinnati orders are scarce, but some companies are finding a small pick up, the first in several months. Shops are running with such small forces that labor trouble is remote.

• Detroit is in what one machinery man calls a vacation period as car builders wait to see the reaction of the public to price reductions and announcements of "standard" lines. With few exceptions production schedules are tapering off. Plans for new models are in abeyance until the labor situation clears up. Cleveland companies that sell mostly to automobile manufacturers are not doing as well as those with a more diversified list of customers. On the whole, however, there has not been much change in the rate of industrial activity.

• The exception to the existing dullness is Chicago where several dealers report good business in May and plenty of inquiries to work on. Milwaukee is not quite so well off as labor troubles disturb the situation. Little change is reported from St. Louis although close observers see a gradual recession in orders which has been going on for some weeks. Threat of labor trouble is worrying employers generally.

France to Revive Machine Tool Industry

According to a recent report to the Department of Commerce by Lestrade Brown, assistant trade commissioner, the French Government is making great efforts to help the machine tool industry and wherever possible favors local manufacturers. However, even now, certain types of machines cannot be had in France, especially for the automotive business, and these are still being bought abroad.

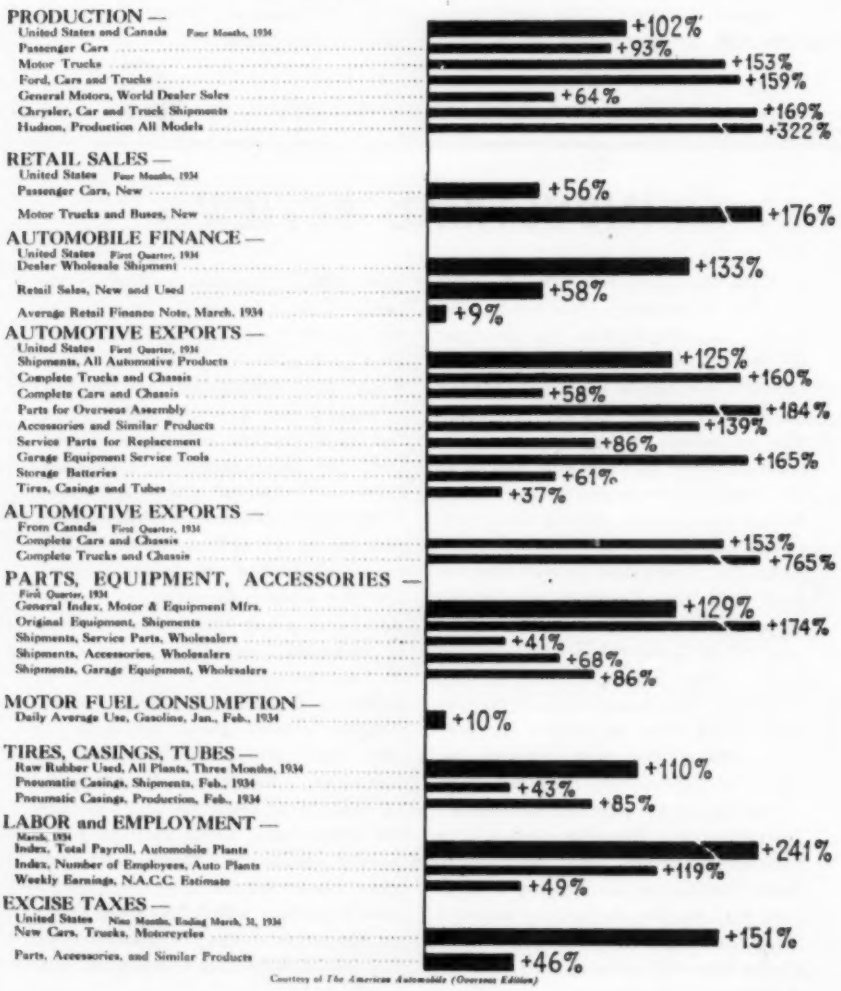
The French machine tool industry is working at 30 per cent of normal, which means there are approximately 3,000 persons employed as against 10,000 in 1929 and 1930. This number is quite small when it is considered that the amount of money invested in this industry has been estimated at 250,000,000 francs. The industry, of course, is still in its infancy and is suffering acutely from German and American competition, but the quotas have now gone a long way to protect it, especially as imported machinery could undersell similar French machinery.

Some time ago, a group of French machine tool manufacturers edited a pamphlet, which was sent around to prospective buyers, in which it endeavored to convince them that it was their duty, as well as their interest, to buy all their machine tools in France. Among the arguments set forth, the following points were stressed: They would save money, would obtain on the home market machines of equal value with foreign and at the same time have greater security of upkeep; would contribute to national wealth and improve France's trade balance rather than aggravate it; would help bring down the high cost of living, taxes and other such charges; would help unemployment; would encourage the efforts of the French machine tool constructors who have for many years placed at their disposal up-to-date machinery, and thus benefit by a general improvement in trade. At the same time the group is carrying on a campaign by which it hopes to have all types of machinery placed under quota or the duty raised by at least 100 per cent; since it has started it has had remarkable success. By the decree of March 21, duties were doubled for articles coming under Tariff item 525 C, "Machines de Mecanique General," and at the present time they are trying to obtain quotas for 525 D, "Machines a travailler les engrenages," 525 E "Machines a affuter," 525 bis B "Material hydraulique" and 525 bis M "Outillage Electrique Portatif."

One of the reasons given to justify the application of customs restrictions is that imports of machines under 525 C in 1933 from the United States were 4,333 metric quintals, 20 per cent in excess of 1932, from Great Britain 2,244 metric quintals, and from Germany 11,528 metric quintals. For the first 75 days of 1934, imports from the United States amounted to 4,363 metric quintals, which is slightly more than those for the full year 1933. The constantly increasing volume of imports was said to be a serious menace to the French industry which would have been totally ruined had it not been for the energetic steps taken for the establishment of the quotas of December 21, 1933, and the increased duties of March 21, 1934. According to a statement by M. Garanger, secretary of the Groupe des Constructeurs de Machines-Outils, this is the favorable time for American firms to contact French builders for the sale of manufacturing licenses, as several members of his group have already informed him of their interest in such purchases.

AUTOMOTIVE RECOVERY PROGRESS

Significant changes in various sections of the automotive industry, typical of gains made thus far in 1934 in comparison with the same periods of 1933. Although some increases may overstate the comparative recovery, the broad scope of the gains, running through practically every section of the industry, reveals that gratifying progress has been achieved in the restoration of more normal conditions.


PRODUCTION —
United States and Canada Four Months, 1934
Passenger Cars +102%
Motor Trucks +93%
Ford, Cars and Trucks +153%
General Motors, World Dealer Sales +159%
Chrysler, Car and Truck Shipments +64%
Hudson, Production All Models +169%
+322%
RETAIL SALES —
United States Four Months, 1934
Passenger Cars, New +56%
Motor Trucks and Buses, New +176%
AUTOMOBILE FINANCE —
United States First Quarter, 1934
Dealer Wholesale Shipment +133%
Retail Sales, New and Used +58%
Average Retail Finance Note, March, 1934 +9%
AUTOMOTIVE EXPORTS —
United States First Quarter, 1934
Shipments, All Automotive Products +125%
Complete Trucks and Chassis +160%
Complete Cars and Chassis +58%
Parts for Overseas Assembly +184%
Accessories and Similar Products +139%
Service Parts for Replacement +86%
Garage Equipment Service Tools +165%
Storage Batteries +61%
Tires, Casings and Tubes +37%
AUTOMOTIVE EXPORTS —
From Canada First Quarter, 1934
Complete Cars and Chassis +153%
Complete Trucks and Chassis +765%
PARTS, EQUIPMENT, ACCESSORIES —
First Quarter, 1934
General Index, Motor & Equipment Mfrs. +129%
Original Equipment, Shipments +174%
Shipments, Service Parts, Wholesalers +41%
Shipments, Accessories, Wholesalers +68%
Shipments, Garage Equipment, Wholesalers +86%
MOTOR FUEL CONSUMPTION —
Daily Average Use, Gasoline, Jan., Feb., 1934 +10%
TIRES, CASINGS, TUBES —
Raw Rubber Used, All Plants, Three Months, 1934 +110%
Pneumatic Casings, Shipments, Feb., 1934 +43%
Pneumatic Casings, Production, Feb., 1934 +85%
LABOR and EMPLOYMENT —
March, 1934
Index, Total Payroll, Automobile Plants +241%
Index, Number of Employees, Auto Plants +119%
Weekly Earnings, N.A.C.C. Estimate +49%
EXCISE TAXES —
United States Nine Months, Ending March 31, 1934
New Cars, Trucks, Motorcycles +151%
Parts, Accessories, and Similar Products +46%

Courtesy of *The American Automobile (Overseas Edition)*

China Seeks to Buy Railroad Equipment

An opportunity for the Export-Import Bank to start functioning presented itself when a Chinese railroad recently sought prices and terms on a large amount of equipment. The Hangchow-Pingsiang Railway of China wants the following: 94,000 metric tons of 85-pound rails; 45 locomotives; 60 passenger car underframes, 68 to 72 ft. in length; 500 freight cars of 30 to 40 tons capacity; shop equipment, and 500,000 new sleepers or rail supports.

The following used equipment for a telephone system is also sought by the railroad: 175 short tongs of galvanized

Metal-Working Code Hearings Scheduled

Date	Place	Deputy Administrator	Association
June 7	Willard Hotel	J. B. Weaver	National Council of American Shipbuilders (modification)

iron wire S.W.G. No. 12; 2,100 lb. annealed copper wire S.W.G. No. 16; double cup porcelain insulators; 108 wall type telephones; 100 desk sets; 12 portable sets; 2 sets for central control; 24 Morse sound instruments, and dispatching instruments for 48 stations.

Half of the equipment is sought for delivery this year, and the rest for 1935 if prices and credit terms are acceptable.

Water Heater Manufacturers Adopt Code

The executive committee of the Indirect Water Heater Manufacturers Association has withdrawn the industry's proposed code. In its place, the code for the heat exchange industry, approved on October 11, 1933, has been adopted for the heater manufacturers.

German Exchange Control Restricts U. S. Exports

Through the tightening of the German exchange control law, that country, pursuing strongly nationalistic tendencies, has seriously curtailed the market for American machinery, according to advices received by the Department of Commerce.

Under a law adopted in 1932, only the German government can deal in foreign exchange. The Government can sell foreign exchange to importers there under two different categories:

1. Importers who regularly imported during 1930 and 1931 can obtain regular quarterly exchange contingents and under them regular monthly exchange quotas. These quotas can be spent any where and for anything, except that they must be used only for payment of foreign goods of exactly the same nature as imported in the past.

During 1932, this law was not strictly enforced and textile manufacturing concerns, which should have been limited under it to the purchase of raw materials, also bought machinery with their exchange allotments. Such practices have been stopped now.

2. Importers who could not obtain regular monthly quotas were permitted to purchase small amounts of foreign exchange, but the law provided that this exchange could not be used to import foreign merchandise regularly imported, except merchandise of vital necessity. This provision, although apparently not put into force last year, is now effective.

• PERSONALS •

E. C. Atkins Company Announces Promotion

Edward W. Clark, for twenty-five years in charge of the New York branch of E. C. Atkins & Co., has been promoted to the position of assistant general sales manager, at Indianapolis. Edward S. Norvell, formerly sales manager of the Indianapolis division succeeds Mr. Clark as local manager in New York.

CHARLES T. SCANNELL has been made general manufacturing manager of the Buick Motor Co., Flint, to succeed GEO. T. CHRISTOPHER, resigned. Mr. Scannell had been factory manager.

M. M. GILMAN has been made vice-president and general manager of the Packard Motor Car Co., Detroit. Previously he had been vice-president in charge of distribution.

WALTER F. TITUS has been made assistant to the president of the International Business Machines Corp., Endicott, N. Y. He will have complete charge of plant operations.

E. A. HERR has been made purchasing agent by Servel, Inc., Evansville, Ind. Mr. Herr was formerly connected with the purchasing department of the Frigidaire Division, General Motors Corp.

ARTHUR B. SCHNELL, for the last two years supervisor of the valve department of Aluminum Industries, Inc., Cincinnati, has been made plant superintendent.

SETH H. TAYLOR, JR., has been appointed Pacific Coast manager for the Lincoln Electric Co., Cleveland. Mr. Taylor's headquarters will be at San Francisco.

LEE B. GREEN, formerly works manager, was elected a director and vice-president in charge of operations of the Globe Machine & Stamping Co., Cleveland, at a recent meeting of the stockholders. Mr. Green became works manager in 1929. His previous experience included: chief engineer of the Stereotype Company, general master machanic of the Timken Roller Bearing Co., and superintendent of the Lincoln Motor Company.

LEE B. GREEN

• OBITUARIES •

Chester B. Lord Dies Suddenly

Chester B. Lord, for five years associate editor of *American Machinist*, died on May 26 as the result of an accident which occurred while on a visit to Pennsylvania a month ago. After being educated at the University of Omaha, Mr. Lord spent three years in railroad and harbor work in South America. Later he held supervisory positions with R. Hoe & Co., the Tubular Dispatch Co. and the Victor Talking Machine Co.

For five years Mr. Lord served as

foreman with the General Electric Co. and for eleven years as general superintendent of the Wagner Electric Co. Other business connections were with the Advance Rumely Co., the National Automatic Tool Co. and as a partner in the consulting firm of Wallace, Delaney & Lord. For four years before joining the staff of *American Machinist* Mr. Lord was superintendent of shops at the Newport News Shipbuilding & Dry Dock Co.

ADOLPHE S. DEUTSCH, president of the Monarch Aluminum Ware Co., Cleveland, died in Rochester at the age of 81.

WILLIAM J. KING, general manager of the King Tool & Grinding Co., Cleveland, died recently at the age of 64.

CLYDE E. LOWE, president of the Clyde E. Lowe Co., Cleveland, manufacturer of rubber machinery, died on May 19, at the age of 49.

R. K. RANDALL, 44, president of the Cleveland School of Welding, Cleveland, died April 24. He was a member of the American Welding Society and of the Cleveland Engineering Society.

• PATENTS •

May 15, 1934

Metal-Working Machinery

Broaching Machine. Richard A. Thompson, Ann Arbor, Mich. Patent 1,958,501.

Milling Machinery. Walter D Archea, Cincinnati, Ohio, assigned to the Cincinnati Milling Machine Co. Patent 1,958,507.

Machine Tool for Machining Couplings and the Like. Fred H. Bogart, Cleveland Heights, Ohio, assigned to the Warner & Swasey Co. Patent 1,958,530.

Gear Testing and Lapping Machine. Oliver G. Simmons, Lakewood, Ohio, assigned to the National Tool Co. Patent 1,958,550.

Grinding Machine. Everard Stubbs, Springfield, Vt., assigned to Norton Co. Patent 1,958,551.

Forging Ram and Rod Connection. Samuel B. Hepperstall, Pittsburgh, Pa., assigned to Heppenstall Co. Patent 1,958,621.

Apparatus for Thin-Wall Broaching. Walter F. Klein, Milwaukee, Wis., assigned to Snap-On Tools, Inc. Patent 1,958,705.

Grinding Machine. Howard W. Lanyon, Chicago, Ill., assigned to the Safety Grinding Wheel & Machine Co. Patent 1,958,709.

Drilling Attachment. Dudley B. Bullard, Southport, Conn., assigned to the Bullard Co. Patent 1,958,844.

Riveting Machine. William Stever, Philadelphia, Pa., assigned to Edward G. Budd Manufacturing Co. Patent 1,958,869.

Tool Holder for Nibbling Machines. Kenneth J. Chapman, Knoxville, Tenn., assigned to W. J. Savage Co., Inc. Patent 1,958,941.

Oscillating Grinder. George M. Le Tarte, Detroit, Mich. Patent 1,959,103.

Tools and Attachments

Adapter and Tool Holder. Carl G. Gase, Cleveland, Ohio, assigned to the Weldon Tool Co., Cleveland, Ohio. Patent 1,958,817.

Work Engaging Device for Screw Machines and the Like. Guy Laughlin, Birmingham, Mich. Patent 1,958,828.

Tool Holder. Samuel Peterson, Detroit, Mich. Patent 1,959,140.

Processes

Method of Generating Hourglass Worms. Oliver G. Simmons, Lakewood, Ohio. Patent 1,958,958.

May 22, 1934

Metal-Working Machinery

Milling Machine. Arthur F. Bennett, West Barrington, R. I., assigned to Brown & Sharpe Manufacturing Co. Patent 1,959,329.

Milling Machine. Newman M. Marsilius, Bridgeport, Conn., assigned to the Bridgeport Bronze Co., Patent 1,959,435.

Arbor Support. Benjamin P. Graves, Edgewood, and Arthur F. Bennett, West Barrington, R. I., assigned to Brown & Sharpe Manufacturing Co. Patent 1,959,952.

Press Construction. Fredrich J. Rode and Rudolph W. Glaesner, Chicago, Ill. Patent 1,960,166.

Tools and Attachments

Boring Tool Holder or Boring Bar. Roy V. Russell, Middletown, Ohio. Patent 1,960,124.

• EXPORT • OPPORTUNITIES

Jóse P. López, Manzana de Gomez 366 (P. O. Box 2249), Habana, Cuba; wants information about machinery for closing cans after preserved food (lobsters) have been put in.

*7427. Haifa, Palestine. Clothes-pressing machines.

*7436. Wormerveer, Netherlands. Woodworking machinery, stationary and portable, small.

*7438. Oslo, Norway. Ice-cream manufacturing machinery, commercial.

*Interested American firms and individuals may obtain the names and addresses of the foreign firms making these inquiries upon application to the Bureau of Foreign and Domestic Commerce, U. S. Dept. of Commerce, Washington, or any district or cooperative office.

• BUSINESS ITEMS •

Remington Arms Co., Bridgeport, Conn., has acquired the Parker Bros. gun-manufacturing plant at Meriden, Conn., The Charles Parker Co. will remain in the Parker family, and will continue to manufacture vises, wood screws and brass ware.

Remington-Noiseless Typewriter Co., Middletown, Conn., is constructing two-story additions 60x120 ft. and 30x70 ft., for completion in July.

The Federal Cutlery Co., Meriden, Conn., will move its plant to Plainville, Conn., and occupy the Edwin Hills factory, where more floor space is available.

Plume & Atwood Mfg. Co., Waterbury, Conn., has purchased the machinery of the American Ring Co. and will reorganize the company and continue operations.

The Henry & Wright Mfg. Co., a Connecticut corporation, has acquired the assets and good will of the Henry & Wright Mfg. Co., a Massachusetts corporation, and is manufacturing all lines of machine tools and presses made by the Massachusetts corporation. FRANK K. SIMMONS, head of the old company, is president of the new concern.

The Buckeye Jack Mfg. Co., Inc., has been organized to take over and continue operation of the defunct Buckeye Jack Mfg. Co., Alliance, Ohio. H. E. BLASINGHAM, is president and general manager. ALEX ROBERTSON, works manager of the Alliance, Ohio, plant of the American Steel Foundries, is a director.

The Geometric Tool Co., New Haven, Conn., has appointed the following agents for its threading tools, threading machines and similar products; Ducommun Corporation, 219 Central Ave., Los Angeles, Calif., representative in Southern California; Star Machinery Company, 1731-1741 First Ave., South, Seattle, Wash., for the states of Washington and Oregon.

The Swind Machinery Co., Philadelphia, machine tool dealer, has appointed J. W. NEIDHARDT as representative covering the southern territory comprising of Virginia and the southern part of Maryland. Mr. Neidhardt was formerly assistant superintendent of Deitrich & Harvey.

The Dickey-Grabler Co., Cleveland, Ohio, has appointed P. R. DUDLEY, formerly of Philadelphia, as representative in Northern Ohio, Western Pennsylvania, Southwestern New York and Southern Michigan. Mr. Dudley is doing special sales work for the metal stamping division of the company.

The Fabreeka Belting Co. has changed its name to the Fabreeka Products Co., because of the increased sale of its material for uses other than belting. On June 15 the company will move its offices from 20 East St., Boston, to larger quarters at 77 Franklin St. Officers are PHILIP W. WRENN, president, JOHN S. CODMAN, treasurer, and WILLIAM B. BRENNAN, vice-president.

• MEETINGS •

THE AMERICAN ELECTRO - PLATERS' SOCIETY. Convention, June 11-14, Statler Hotel, Detroit, Mich. T. C. EICHSTAEDT, secretary, Statler Hotel, Detroit.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Summer meeting, June 25. Cosmopolitan Hotel, Denver, Colo. CALVIN W. RICE, secretary, 29 West 39th St., New York, N. Y.

AMERICAN SOCIETY FOR TESTING MATERIALS. Annual meeting, June 25-29. Chalfonte-Haddon Hall, Atlantic City, N. J. A. E. HESS, assistant secretary, 260 South Broad St., Philadelphia, Pa.

SOCIETY OF AUTOMOTIVE ENGINEERS. Summer meeting, June 17-22. Saranac Inn, Saranac Lake, N. Y. JOHN A. C. WARNER, secretary, 29 West 39th St., New York, N. Y.

American Machinist

REFERENCE BOOK SHEET ©

Sizes of Standard Milling Cutters—V

Simplified Practice Recommendation R36-34, Milling Cutters, as revised by the industry and issued by the National Bureau of Standards, effective April 15, 1934.

Stocking Cutters for Involute Gears

Standard Hole

[Carbon, and high-speed steel.]

Diametral Pitch	Diameter of Cutter	Size of Hole	Diametral Pitch	Diameter of Cutter	Size of Hole
*1	8½	2	3	4¾	1¼
*1¼	7¾	2	4	4¼	1¼
*1½	7	1¾	5	3¾	1¼
1¾	6½	1¾	6	3⅛	1
2	5¾	1½	7	2⅞	1
2½	5¾	1½	8	2⅞	1

Cutters marked * are not kept in stock but are made to order.

1-In. Hole			1¼-In. Hole		
4	3⅝	1	6	3½	1¼
5	3⅜	1	7	3⅜	1¼
			8	3¼	1¼
1½-In. Hole			**1¾-In. Hole**		
3	5¼	1½	2	6½	1¾
4	4½	1½	2½	6⅛	1¾
5	4¼	1½	3	5⅝	1¾
6	3⅞	1½	4	4¾	1¾
			5	4⅜	1¾

Concave and Convex Cutters

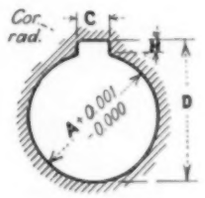
[Carbon, and high-speed steel. Cutters can be sharpened without changing their outline.]

Diameter of Circle	Diameter of Cutter	Size of Hole	Diameter of Circle	Diameter of Cutter	Size of Hole
⅛	2	⅞	½	2¼	⅞
3/16	2	⅞	5/8	2¾	1
¼	2	⅞	¾	3	1
5/16	2¼	⅞	⅞	3¼	1
⅜	2¼	⅞	1	3¼	1
7/16	2¼	⅞			

Corner-Rounding Cutters

[Standard in either right- or left-hand single style. Formed teeth can be sharpened without changing their outline.]

Radius of Circle	Diameter of Cutter	Size of Hole
⅛	2	⅞
¼	2¼	⅞
⅜	3	1
½	3¼	1
⅝	3½	1



Standard Keyways for Cutters

Bore and Key

[1]Cutter Bore "A," Inches	Nominal Size Key (Square), Inches	Dimensions — Inches					
		C		D		H	Corner Radius
		Maximum	Minimum	Maximum	Minimum	Nominal	
½	3/32	0.106	0.099	0.567	0.557	3/64	.020
⅝	1/8	.137	.130	.708	.698	1/16	1/32
¾	1/8	.137	.130	.832	.822	1/16	1/32
⅞	1/8	.137	.130	.957	.947	1/16	1/32
1	¼	.262	.255	1.114	1.104	3/32	3/64
1¼	5/16	.325	.318	1.395	1.385	⅛	1/16
1½	⅜	.410	.385	1.676	1.666	3/32	1/16
1¾	7/16	.473	.448	1.958	1.948	1/16	1/16
2	½	.535	.510	2.208	2.198	1/16	1/16
2½	⅝	.660	.635	2.743	2.733	3/32	1/16
3	¾	.785	.760	3.275	3.265	¼	1/32
3½	⅞	.910	.885	3.900	3.890	3/16	1/32
4	1	1.035	1.010	4.400	4.390	3/16	1/32
4½	1⅛	1.160	1.135	4.963	4.953	7/32	1/32
5	1¼	1.285	1.260	5.525	5.515	½	⅛

[1]For intermediate size bore use the keyway for the next larger size bore listed

American Machinist — REFERENCE BOOK SHEET ©

Sizes of Standard Milling Cutters—VI

Simplified Practice Recommendation R36 34, Milling Cutters, as revised by the industry and issued by the National Bureau of Standards, effective April 15, 1934.

Spur Gear Hobs

14½ Deg. Pressure Angle

[Ground hobs, carbon steel hobs and those having dimensions or pitches other than listed, are special.]

Diametral Pitch	Outside Diameter	Length	Size of Hole	Diametral Pitch	Outside Diameter	Length	Size of Hole
1	10¾	15	2½	2	5¾	8	1½
1¼	8¾	12	2	2¼	5¼	7½	1½
1½	8	10	2	2½	5	7	1½
1¾	7¼	9	2	2¾	4¾	6	1½

1¼-In. Hole, ¼ x ⅛-In. Keyway

Pitch	Diameter	Length	Pitch	Diameter	Length
3	4½	5	14	2½	2½
3½	4¼	4¾	16	2½	2½
4	4	4	18	2½	2½
5	3½	3½	20	2½	2½
6	3¼	3¼	22	2½	2
7	3	3	24	2½	2
8	3	3	26	2½	2
9	3	3	28	2½	2
10	2¾	2¾	30	2½	2
12	2¾	2¾			

¾-In. Hole, ⅛ x 1/16-In. Keyway

12	2	2	32	1⅞	1½
14	1⅞	1⅞	34	1⅞	1½
16	1⅞	1⅞	36	1⅞	1½
18	1⅞	1⅞	38	1⅞	1½
20	1⅞	1⅞	40	1⅞	1½
22	1⅞	1⅞	42	1⅞	1½
24	1⅞	1⅞	44	1⅞	1½
26	1⅞	1⅞	46	1⅞	1½
28	1⅞	1⅞	48	1⅞	1½
30	1⅞	1½	50	1⅞	1½

½-In. Hole, ⅛ x 1/16-In. Keyway

24	1¼	1¼	38	1⅛	1⅛
26	1¼	1¼	40	1⅛	1⅛
28	1¼	1¼	42	1⅛	1⅛
30	1⅛	1⅛	44	1⅛	1⅛
32	1⅛	1⅛	46	1⅛	1⅛
34	1⅛	1⅛	48	1⅛	1⅛
36	1⅛	1⅛	50	1⅛	1⅛

Double Angle Milling Cutters

[Carbon and high-speed steel. Furnished with an included angle of 45, 60 or 90 deg.]

Diameter	Thickness	Size of Hole
2¾	½	1

Screw Arbors

[These arbors are designed to take single angle milling cutters as listed previously (*AM*—Vol. 78, page 350). In ordering, state whether right- or left-hand arbors are wanted.]

N. F. Thread on Arbor	B. & S. Taper Shank	Diam. of Cutter Arbor Will Take
⅜–24	7	1¼
½–20	9	1⅝

Two-Lipped End Mills With Brown & Sharpe Taper Shank

[Standard in high-speed steel only, with either right- or left-hand cut, straight or spiral flutes. Right-hand mills have right-hand spiral flutes and left-hand mills have left-hand spiral flutes. End mills with No. 5 B. & S. taper shank are regularly furnished without tang; with No. 9 B. & S. taper shank will be considered standard with either tang end or shank tapped for draw-in bolt.]

Diameter	Taper	Length of Cut	Length Overall	Diameter	Taper	Length of Cut	Length Overall
¼	5	⅜	2 9/16	⅝	7	13/16	4 13/16
¼	7	⅜	4 3/8	¾	7	1 1/8	5 1/8
5/16	5	7/16	2 11/32	⅞	7	1 5/16	5 5/16
5/16	7	7/16	4 11/32	1	9	1½	6¾
⅜	7	9/16	4 9/16	1¼	9	1⅞	7⅛
7/16	7	11/16	4 11/16	1½	9	2¼	7½
½	7	¾	4¾				

Two-Lipped End Mills With Straight Shanks

[Standard-in. high-speed steel only, with either right- or left-hand cut, straight or spiral flutes. The diameter of the shank is the same as the diameter of cut.]

Diameter	Length of Cut	Length Overall	Diameter	Length of Cut	Length Overall
¼	⅜	1 7/16	½	¾	2 1/16
5/16	7/16	1 9/16	⅝	13/16	2 1/16
⅜	9/16	1⅝	¾	1⅛	2½
7/16	11/16	2			

Shell End Mills

[Standard in high-speed steel only, with spiral flutes, and either right- or left-hand cut.]

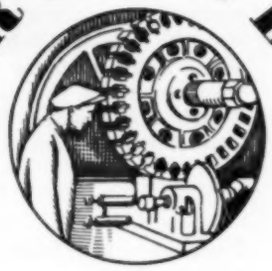
Diameter	Length of Cut	Size of Hole	Size of Driving Slots: Width	Size of Driving Slots: Depth	Diameter	Length of Cut	Size of Hole	Size of Driving Slots: Width	Size of Driving Slots: Depth
1¼	1	½	¼	5/32	3	1¾	1¼	½	5/32
1½	1⅛	½	¼	5/32	3½	1⅞	1¼	½	5/32
1¾	1¼	⅝	5/16	5/16	4	2¼	1½	⅝	⅜
2	1⅜	¾	5/16	5/16	4½	2¼	1½	⅝	⅜
2¼	1½	1	⅜	7/32	5	2¼	1½	⅝	⅜
2½	1⅝	1	⅜	7/32	5½	2¼	2	¾	7/16
2¾	1⅝	1	⅜	7/32	6	2¼	2	¾	7/16

T-Slot Cutters With Brown & Sharpe Taper Shank

[Standard in high-speed steel only, with staggered teeth and either right- or left-hand cut. T-Slot cutters with No. 5 Brown & Sharpe taper shank are regularly furnished without tang.]

Bolt Size	Diameter of Cutter	Thickness of Cutter	Diameter of Neck	Length Overall	Taper
¼	9/16	13/64	17/64	2⅝	5
5/16	11/16	17/64	21/64	2 23/32	5
⅜	13/16	21/64	13/32	4 13/16	7
7/16	15/16	25/64	15/32	5	7
½	1 1/16	29/64	17/32	5¼	7
5/8	1¼	37/64	21/32	6⅞	9
¾	1 15/16	⅝	25/32	7¼	9
1	1 27/32	49/64	1 1/32	7 13/16	9
1¼	2 7/32	1 3/32	1 9/32	10⅜	10
1½	2 23/32	1 11/32	1 17/32		

THE ROUND TABLE



Works Councils and Unions

"I hear Williams is suggesting that you form some sort of a welfare board at your shop, Ed. Looks like he's either scarced of labor trouble or getting soft."

"Don't kid yourself, Al. He's neither one. And it isn't a welfare board at all, it's a works council, and I'm for it."

"Company unions are in bad odor, Ed. Why don't he have the men join the A. F. of L. and be done with it? They've got a perfect right to under Section 7a of the Recovery Act, you know."

"Sure they have, Al. And Williams don't believe in the company dominated union you're talking about either. But if you know anything of what has been done in a number of shops, you know that works councils have done a lot of good work. They don't wait till there is a big grievance and then try to iron it out. Regular meetings, with both men and management represented, catch them before they grow big enough to make trouble."

"I know that's the theory, Ed. But it seems to me like a fine chance to waste time, and I can't imagine Williams letting a few of the men run the shop for him."

"Of course they won't. What's more, they don't want to. How many men have you got that want to take any more responsibility than they have to? But you've got the wrong slant entirely, Al."

"Well, what's the use of the men having any fingers in the pie if they can't run things to suit themselves. And if they did—good night."

"Just how much do you have to do with running this town, Al? You never miss a vote of course, but where does that get you besides expressing your opinion? You'd be sore if you couldn't vote, but you know it doesn't affect things much. Much less than the men's votes do in the works council."

"Then you admit it's a set-up, that it doesn't do them any good."

"Nothing of the sort, Al. That's the company union maybe, but not a real works council. Both men and management elect members who meet regularly. They bring up questions that affect the men, the management or the plant. This includes hours, wages, shop conditions, safety and a lot of other things. Instead of letting little things go unattended until they grow big and make sore spots, they are discussed and changed promptly when changes are to be made."

"What happens if they don't give in to the men on all questions? The men aren't always right, you know, Ed."

"Of course not. But it's a lot easier to show what can and what can't be done in a friendly round table discussion than by issuing orders or statements. And men are not usually unreasonable if they can be shown that requests can't be met at the moment."

"Suppose some of the men want to join a union instead of the works council. How can you divide up authority, or whatever you call it?"

"That's open to discussion, Al. When you vote for mayor you have to be guided by the majority whether you like it or not. I feel that any man coming to work in a plant where there's a works council chosen by a majority of the men has no right to question their actions, except by voting when he has the chance. He must be governed by the majority."

"Well, Ed, if I was going in for so much democracy, I'd probably join an outside union. Suppose a third of the men prefer the A. F. of L., why should they be governed by the works council?"

"There's the theory stuff again, Al. I believe the works council plan can be made so attractive men will prefer it. But I'm for majority rule in any case."

Is Al sound in opposing Williams' works council plan? Is Ed right in making majority rule govern those who prefer a national union? Or should each group have separate representation?

Discussion

What Share?

I've discussed this problem at various times with representatives of various labor unions and with self-appointed labor heads. Their opinion as to labor's share varied from 25 to 75 per cent of the profits.

To attempt to give a definite answer, that is, a definite percentage is a rash thing for any one to do. Voicing, however, the general opinion of labor a fair share is 50 per cent. In other words, it's a 50-50 proposition—the stockholders contributing the money and the workers the labor.

An interesting side of the problem arises when a discussion of the losses begins. Somehow, labor seems to lose interest. Then the matter drops to a 75-25 proposition or less. As a matter of fact, it then doesn't become a proposition. It's simply a matter of the owners and stockholders assuming the losses but the workers must be paid.

Under the present system, to attempt to place an exact finger on the worker's fair share is impossible. There is but

one way even to attempt to solve the problem—for the employer to pay his workers the highest possible wage per hour compatible with the value of their work and his profits.

To assume any more is dangerous. When labor heads, themselves, are puzzled as to what is a fair share it is time to pay a living wage all around, and to let sleeping dogs lie. The problem will only be solved when the government takes the matter into its own hands or when our form of government is drastically changed.

—Will Herman,
Superintendent,
Tanenbaum Oil Company.

Much has been written around the "partnership" of capital and labor, but so long as employees are hired at a fixed rate, the partnership is purely imaginary.

The introduction of a profit-sharing scheme is but elementary justice, since all who help to make profits should receive a share. Therefore, remuneration for labor should be by a fixed basic rate plus a yearly or half-yearly bonus, the amount of which would depend upon the profits, and not to be paid until after the regular stockholders had received a fixed percentage on their holdings. Employees would become eligible for the bonus only after three or five year's service, and the amount given each individual would be increased every five years.

Profit-sharing schemes are simple to inaugurate and are welcomed by all classes of labor. In times of prosperity the extra outlay will be paid for by the reduction of labor turnover alone. In times of adversity the absence of the bonus will bring home to the employees the need for cooperation and good will.

—Roy Vernon Wade,
Glasgow, Scotland.

Within Reason?

Sometimes men refuse to do as they are told because of a sense of false pride and sometimes as the result of proper pride. Delegating a high-class mechanic to perform menial tasks is bad business from any standpoint. When a man demurs at cleaning a machine he is, as a rule, feeling too big.

There is a peculiar twist in some men that will permit them to do nothing but one given job, while others are anxious to be given various jobs. Unfortunately, a man with "one-job-itis" hurts both himself and his employer. He cuts himself off from additional and varied experiences that are certain to make him more valuable.

Al's attitude in considering the matter fully before discharging the man is more to be commended from a good business standpoint than is Ed's "obey-or-walk" position, even though it be conceded that the man does wrong in failing to obey. Labor turnover takes too heavy a toll to allow it to mount unduly, even though a foreman's vanity must suffer somewhat to prevent such mounting.

—John E. Hyler.

Unions—Horizontal or Vertical

It is one of the fundamental economic laws that capital and labor must cooperate, and it must be strictly adhered to in order to minimize unwarranted labor troubles. It should be the duty of each union to see that applicants for membership are graded according to their ability. It will then be the duty of the employer to cooperate with the unions in setting a minimum wage for men of each grade. Setting a blanket rate is detrimental to all; men should be paid according to their ability.

In general, the best men will group with the horizontal unions, realizing that should the leadership be controlled by men of superficial character, mistakes made by them would affect but a portion of labor. With the vertical type of union the conditions would be just the opposite.

The type of union having the greatest number of the best men is better for both capital and labor because it is easier to treat with an individual group than with a mass of diversified workers. Unfortunately, due to his psychological makeup, man is charged with a certain amount of greed, be he workman or employer, and this condition will have to be fought before harmonious relations can be established.

—Peter L. Budwitz.

To make the vertical union operate successfully, it is necessary that all individual ideas and ideals must be so crystallized as to present to the employer a practical and clean-cut proposition worthy of his consideration. The various factions must submit their problems so that the vital elements can be quickly and easily discernible. The objectives must be of such scope as will produce the greatest good to the greatest number. If not organized along broad lines, the vertical union will become nothing less than an axgrinding festival. But if it is handled in an efficient and intelligent manner, the most active brains will naturally become its leaders.

In the average horizontal-union meeting, it is not uncommon for a clever talker to convince his audience that present conditions are unbearable. Often the better judgment of an individual tells him that many of the statements made are not true. However, following the path of least resistance, he votes with the majority. In the case of the vertical union with its large membership, the material presented for consideration must have the semblance of soundness before interest can be aroused. If the vertical union does nothing else than hold in abeyance the rattle-brained conceptions of the various groups, it will have fulfilled its mission.

—Harold L. Wynn,
Executive Engineer,
Pacific Electric Mfg. Corporation.

No Inventory

Al can get along without an inventory, but he will be running his shop as a pastime. He certainly knows how many parts he requires to manufacture his product, and he can tell how many he will require in a certain period. He may know how many bars of steel, forgings, castings, nuts and bolts he will require during the next six months, but can he know the difference in their buying cost and their present-day value without an inventory? While Al has given a number of pay increases, does he think he is still getting the same profits?

Ed's concern cannot by any means follow Al's example. There is greater need for an inventory because it has to strive for a profit on every job. It can not add its loss on any particular job to the next order from the same customer because someone will quote a lower price as a first-time job. Ed's concern has to know the current value of raw materials and buy accordingly.

It is surprising when making an inventory how the value of commonplace things grows. Each machine generally has its own collection of bolts and clamps, while occasionally an angle plate may be found inside the bed of a machine. Before all these small collections are merged into one, their current value is sometimes greatly underestimated. Collections of high-speed and "tipped" tools are another aftermath of the inventory and, according to their prevailing cost, they are well deserving of a separate, occasional inventory.

—W. A. Harris,
Coventry, England.

Circular Forming Tools Half a Century Ago

MATTHEW HARRIS

I was very much interested in the series of articles on "Contour Calculations for Forming Tools," by C. W. Johnson (*AM*—Vol. 76, commencing at page 893), and was amazed at the intricate calculations necessary to find the contours of the blanks to give the correct shapes at the cutting edges. I am not attempting to discuss Mr. Johnson's articles (it would be a brave man who would criticize them), but reading the articles brought back memories of the trials and tribulations in making some circular forming tools when I was a young man.

Forming Fifty Years Ago

A little more than fifty years ago I was in responsible charge of a shop engaged in building machine tools and doing some contract work on the side We were approached by a large concern manufacturing brass goods and plumber's supplies as to whether we would undertake to make a lot of forming tools for them. They told us they were using some forming tools they had made themselves, but that they were not altogether satisfactory. We found that the tools they had in mind were simply pieces of rectangular steel machined to shape at the ends, and that some of the steel would have to be upset to make the tools wide enough.

While I do not know whether there were any circular forming tools in use at that time, I do know that I had never seen but one, and that was one we had made ourselves for forming ball-shaped finials on oil-hole stoppers for the machines we built. As the finials fit nothing but wind, no particular accuracy was required as to contour, so that no attempt was made to correct the contour of the tool. We got the idea from using a regular rack cutter attached to a steel shank for planing racks for the machines we built.

We showed our forming tool to our prospective customers and explained its long life and how it would hold its shape through repeated grindings. They were delighted with the tool and wanted to know our price for making tools of that type. Finding that they had in mind ordering at least 25 tools, we quoted a price that we were afraid was prohibitive. We heard nothing further from them for some time, but one day we were surprised to receive an order for 50 tools at the price quoted, the tools to be made to samples to be furnished by our customers.

We now had to consider ways and means for making the tools and were afraid we had bitten off more than we could chew. We knew that circular forming tools gashed below the center for clearance would have a contour at the cutting edges slightly different from that to which the blanks were turned. We also knew that such tools that were smaller in diameter at one end than at the other would have the greater error at the smaller end, due to the decreasing radii as the steps became deeper. But we did not know how to arrive at the proper corrections and had to feel our way. Of course, we knew nothing of the methods described by Mr. Johnson in his articles and would not have known how to use them if we had.

While we were studying over the matter, we set some of our toolmakers to making matched templets, male and female from the customer's samples. We wanted to use the female templets as formers in roughing out the tools, so we made a new toolblock having an integral bracket for carrying the former pin, the templets to be held in a clamp attached to the headstock, as shown in Fig. 1. The turning tool was set as far above the center as the gashes in the forming tools were to be below. Both the transverse and the longitudinal feeds were operated by hand, the depth of cut being controlled by the compound rest. But with the sliding joints of the toolblock and the compound rest as tight as would permit ease of operation, there was enough slack to allow the tool to catch and dig in. As that would never do, we thought of holding the templets at the clearance angle the forming tools were to have, and setting the turning tool at the center.

To feel our way, we laid out a tool on the drawing board, making it about four times as large as the forming tools were to be, as shown in Fig. 2. This tool was designed to have eight steps of ½ in. each. We drew a line at the same angle as that for clearance in the forming tools, and on it we stepped off points ½ in. apart. From these points we drew vertical ordinates to the center line, the distance between these ordinates being the cosine of the angle. From the junctions of the ordinates with the center line we drew arcs to the gash line. We found that the cutting edge at each step formed a separate clearance angle, the angles increasing from 10 deg. 40 min. to 20 deg., and that the steps increased in depth as the center was approached, the variation being from 0.501 to 0.524 inch.

We then laid out all the tools on the drawing board, found the clearance angles at each step and figured the

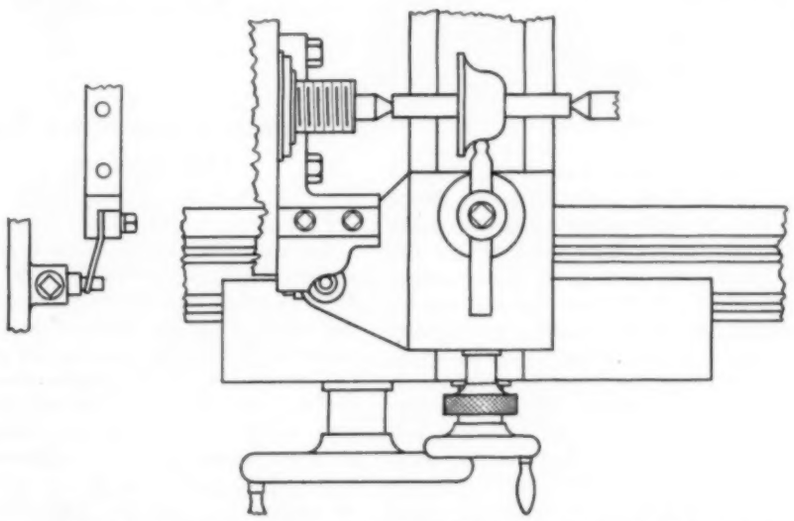


Fig. 1—Roughing out the blanks. The female templet is used as a former

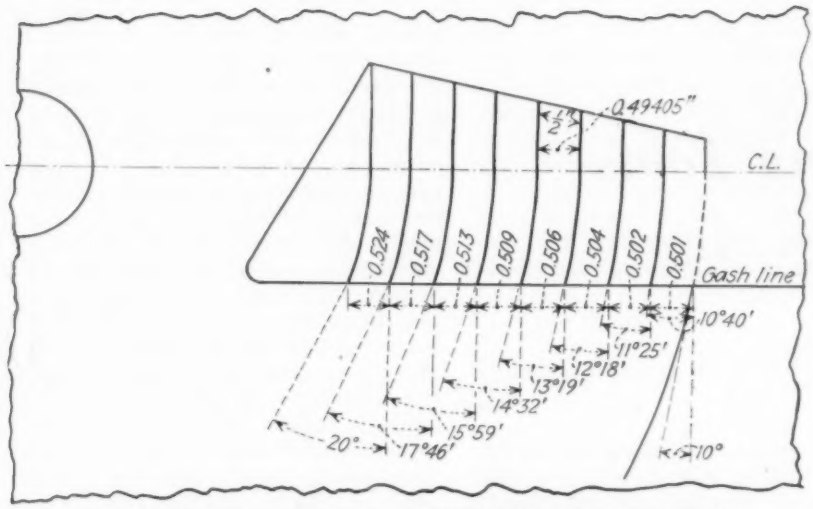


Fig. 2—The enlarged layouts of the forming tools were made about four times the actual size. This shows the method used

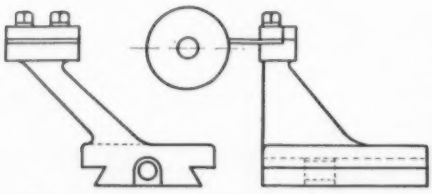


Fig. 3—The offset bracket for holding the male templet

average angle for each tool. Then we bent the templet for each tool to the average clearance angle as determined for that particular tool. The bending was done in a hand brake, to the stationary part of which was attached a large pasteboard dial graduated in degrees and quarters of a degree. A pointer attached to the pivoted part of the brake showed the operator when the bends were at the proper angles. The templets were bent downward, as can be seen in the small view at the left in Fig. 1, so that the lathe operator could the better see the contact of the former pin with the contour. This scheme worked out all right for roughing the blanks, but, of course, some corrections to the contours were necessary, and square shoulders and interior corners had to be tooled out.

While the blanks were being roughed out we made the offset bracket shown in Fig. 3. It was fitted to the cross slide of another lathe, just behind the toolblock and connected to the cross-feed screw. At the top was a clamp for holding the male templets horizontally and as far above the center as the blanks were to be gashed below the center. As the templets could be brought into contact with the blanks by less than half a turn of the cross-feed screw, they were used as guides in correcting the blanks by hand tooling. As a rest for the hand tools, a piece of steel was held in the toolpost approximately parallel with the line of centers. Other than squaring up shoulders and interior corners, and a general smoothing up after the roughing cuts, it was surprising to see how little hand tooling was necessary.

Perhaps if the former pin had been held at a to-be-determined angle, the top inclining toward the front of the lathe, some of the errors would have been minimized. In that case the former pin would have to be slightly elliptical to present a cylindrical section on a horizontal line. Otherwise it would not be the same shape as that of the roughing tool.

After making the necessary corrections, the blanks were gashed, hardened and tempered. Much to our gratification we did not lose a single tool in the heat-treatment. While these tools were probably not nearly so accurate as they would have been if they had been made by Mr. Johnson's method, they passed inspection by our customers and were promptly paid for. What is equally to the point is that we made a nice profit on the job.

Cylinder Bores Once More
Discussion

JAMES MCINTOSH

Referring to the discussion on the above subject (*AM*—Vol. 78, page 208), M. P. Dalton uses the greater part of his article with his explanation of the action of "labyrinth" packing to qualify the grooves to retain jointing material between pipe flanges. However, the real issue is my reference to the design of grooves produced by a single-pointed tool and its application to the cylinders of automotive engines (*AM*—Vol. 77, page 808).

I am quite familiar with the use of grooves to seal small pistons, as in the case of the Thompson steam-engine indicators, one of which I have owned and used for the past 35 years, and in which the piston is groove sealed.

I think that Mr. Dalton can afford to study the action of the Michell bearing on oil films and the decided advantage of that system. Mr. Dalton says "The important effect of sharp, narrow grooves in cylinders of gasoline engines is that with tight, initial-fitting pistons, the surface beds down rapidly and well, owing to the collapse of the ridges between the grooves." Does he believe that the grooves I referred to would increase to wear of cylinder bores?

How about molecular tension building up the oil film into ridges in the network of my suggested grooves; cohesion and adhesion; surface tension and velocity? Because of such actions, indentations in ordinary bearings have increased their carrying capacity.

Equipment for Automobile Repair

Automobile repairing is a much discussed subject. Usually there is more cussing than discussing when it comes up. But when we consider the special tools and machines that have been designed and are now available there is no reason for poor repair work except lack either of skill or reliability on the part of the personnel.

Some of these new machines have been designed and built by men with long experience in high grade machine tool fields. They embody the best principles of machine design. They are designed with a view of simple set-up and operation for individual jobs rather than for the mass production demanded by the factory. Taking one cylinder boring bar as an example, it is located and locked on the block without bolts, a special "mike" enables the cutter to be set to exact size, and a disk charged with diamond dust run from the motor sharpens the carbide cutter.

Machines are also available for turning and grinding pistons to fit the rebored cylinders. The pistons can be ground round or eccentric as desired, with but little labor. Valves and valve seats can be surfaced and reground by simple and accurate devices. Valve seats can be measured for concentricity and angle. Bearings can be rebabbitted, rebored, burnished or honed. Other special equipment is also available.

With the equipment now available for automobile repairs, failure to do a good job can only be attributed to management, in which is included the failure to secure men who know their job and who are dependable.

• IDEAS •
FROM PRACTICAL MEN

Relining Bearing Shells for Trailer Trucks

JOHN M. KUPEL
General Superintendent, Little Giant Products, Inc.

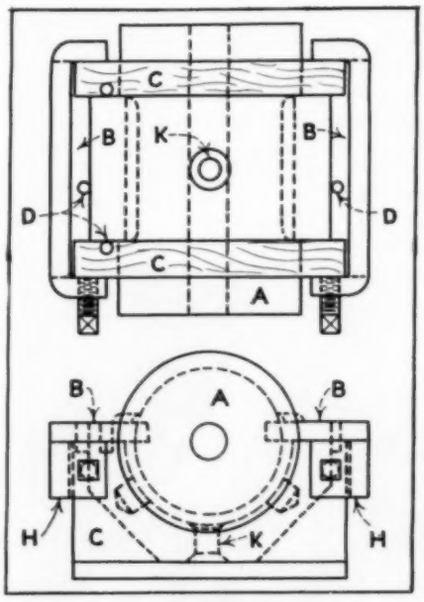
If as may be assumed, trailing-truck axles are standard and uniform in all locomotives of any one class of the same make, the bearing shells can be relined by using the set-up illustrated and will need no machining.

The set-up consists of the recessed mandrel *A;* the stop-off plates *B;* the wooden blocks *C;* the guide pins *D;* and the clamps *H*. The stop-off plates fit snugly in grooves in the mandrel, to which they are lightly welded, acting as dams for the molten lining metal.

Both the shells and the mandrel are preheated and the mandrel is coated with a mixture of graphite and heavy oil. If the mixture is put on too thick, the bearing surface will be seamed. The shell is clamped to the mandrel, fitting between the guide pins in the stop-off plates. If a shell does not fit between the guide pins, it should be fitted, but the guide pins should not be touched; the distance between them should be standard.

The lining metal should not be heated too hot or it will be spoiled by having the lead content burned out. After pouring the lining metal through the hole *K* in the back of the shell, the clamps should be removed and a rod should be slipped through the longitudinal hole in the mandrel to aid in handling the hot assembly. Two blocks should be placed far enough for the shell to go freely between them. The assembly should then be turned upside down and dropped on the blocks so that the ends of the mandrel strike them. That will jar the bearing loose from the mandrel.

If the mandrel has been finished to the right dimensions, no other work on the bearings will be necessary, other than breaking the sharp corners with a file or a scraper.



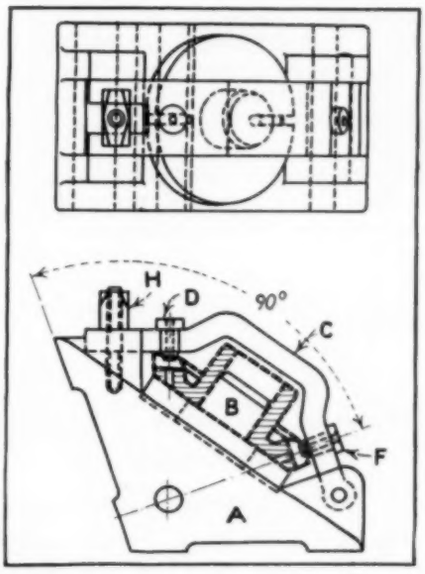
Bearing shells for trailing trucks of locomotives relined by the use of this set-up will need no machining

A Roll-Over Jig

D. L. BROWN

Having to drill two diametrically-opposite oil holes in the tooth spaces of a large quantity of bevel, differential gears, the jig illustrated was designed. Essentially, the jig consists of the base *A;* the locating plug *B;* the hinged bushing-arm *C;* the bushings *D* and *F;* and the clamping nut *H*. The inner ends of the bushings are ground to fit closely between the teeth of the gear.

With the bushing arm swung up to permit loading, the gear is located by the entrance of the plug into the central hole. When the arm is brought down and is locked by the clamping nut, the gear is prevented from rotating by the inner ends of the bushings engaging the tooth spaces. The base of the jig is planed at an angle corresponding to the cutting angle of the gear and the jig is alternately rolled over on its angular faces for drilling the holes.

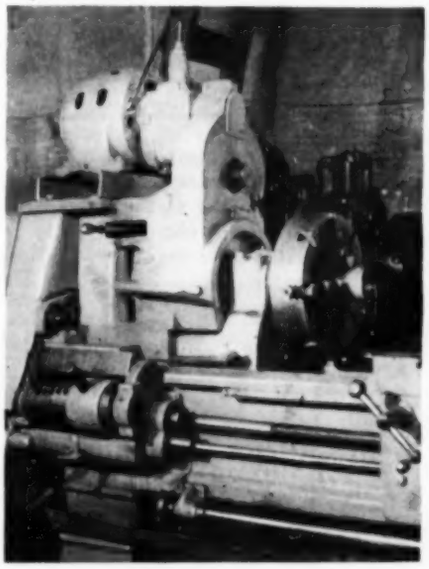


This jig is rolled over from one angular face to the other to bring the bushings in line for drilling the holes

Motor Drive for a Lathe

C. A. GUDERIAN
Machine Shop Instructor Salem High School

In the illustration is shown a motor drive for a lathe in which various speeds were obtained from a constant-speed motor. Patterns and castings were made for a new and heavier end bell for the motor, and on which was mounted a regular Chevrolet transmission.



The lathe is driven by a constant-speed motor connected to a Chevrolet transmission. With a reversing switch, three speeds in either direction are available

The clutch shaft of the transmission was turned down for a press fit in a hole bored in the rotor shaft of the motor. The shafts were then keyed and pressed together, making a continuous shaft from the rotor to the transmission. The front bearing of the transmission takes the place of the regular bearing in the end bell. Ordinarily this device would give three speeds for-

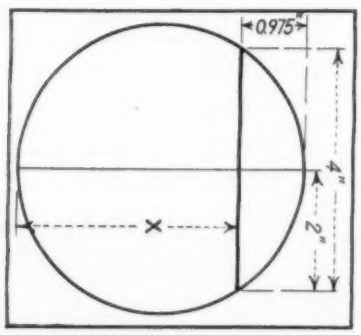
ward and one speed in reverse. With a reversing switch in the circuit, as in this case, three speeds in either direction are available.

This hook-up was built in the machine shop of the Salem High School, Salem, Oregon.

Finding the Diameter Where the Center Is Not Accessible—Discussion

ELMER OLSON

Referring to the articles under the title given above by Paul C. Bruhl, George Belbes and John Roll (*AM*—Vol. 77, pages 184, 636 and 790, respectively), I am submitting a method that



I have found to be simple enough for those who are not acquainted with either algebra or higher mathematics.

Referring to the sketch:

$$0.975 : 2 : : 2 : X$$

$$X = \frac{2 \times 2}{0.975} = 4.10256$$

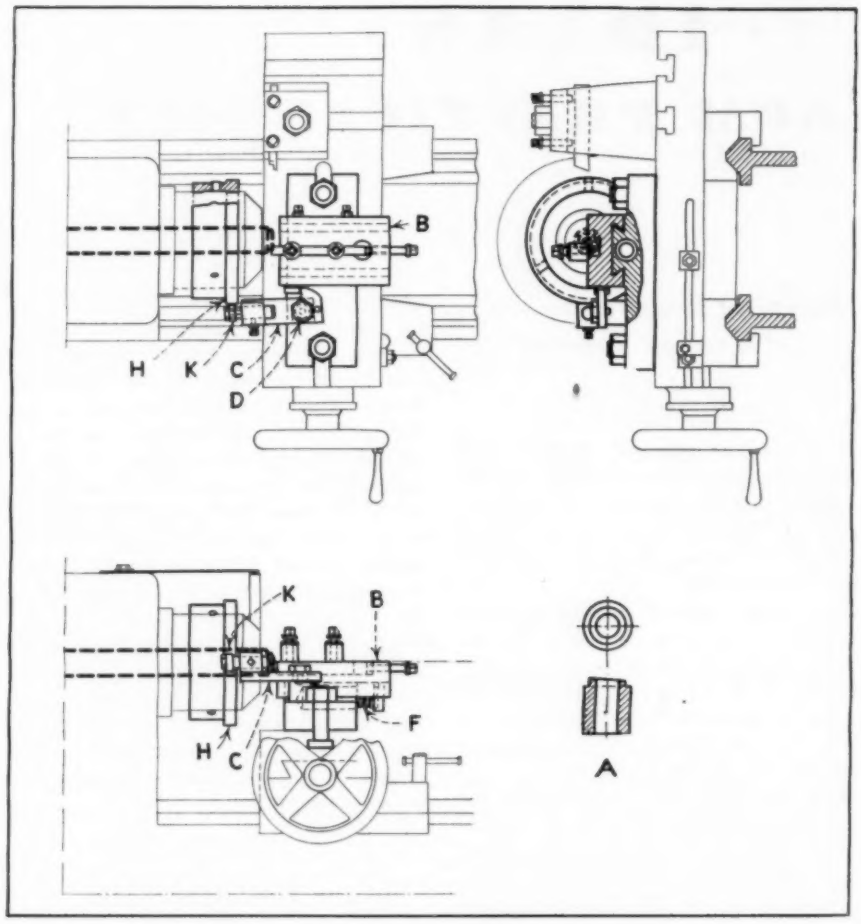
Diameter = 4.10256 + 0.975 = 5.07756

Cam-Cutting Attachment for the Screw Machine

EMIL WITTMANN

Parts such as the one illustrated at *A* are made from brass rod in the screw machine and are used in large quantities in certain electric appliances. The cam on the end was formerly cut in the milling machine as a second operation, using a cam-cutting fixture. To increase production and cheapen the cost of manufacture, I designed the attachment illustrated for use in the screw machine. Essentially, it consists of the toolblock *B*, sliding parallel with the axis of the spindle; the lever *C*, pivoted at *D*; the spring *F*; the master cam *H*; and the cam roller *K*, mounted on a stud in the end of the lever.

In operation, the toolblock is fed inward at right angles to the axis of the spindle. When the cam roller comes into contact with the master cam, reciprocating motion is imparted to the toolblock by means of the toe of the lever and the spring, controlled by the master cam. Continued inward movement of the toolblock causes the lever to swing farther on its pivot and the toe to move the toolblock closer to the spindle, eventually bringing the tool into contact with the work and cutting the cam. To make a slight change in the rise and fall of the cam, the stud on which the cam roller is mounted can be moved in or out on the lever, shortening or lengthening the leverage and changing the proportions of rise and fall in relation to the master cam.



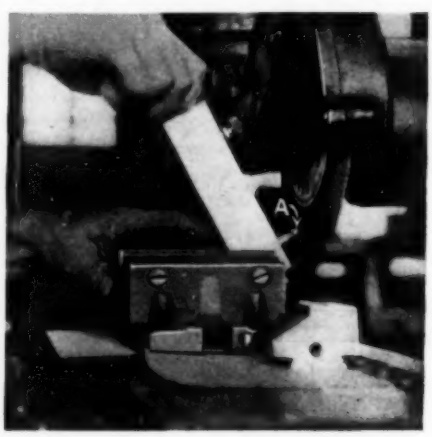
By slight changes in this attachment, face cams of various kinds can be cut in the screw machine at the same setting as for other operations

Dressing Abrasive Wheels at an Angle

HECTOR J. CHAMBERLAND

Because most forming tools are ground after they have been hardened, angular dressing of abrasive wheels on toolroom surface grinders is a common occurrence. Wheels can easily be dressed to the required angles by the device illustrated. It consists of a piece of machine steel ½x½x6 in., sliding in a groove cut in a piece of machine steel ¾x1⅛x6 in. These pieces are ground all over, but are not necessarily hardened. The sliding piece carries the diamond at *A* and is provided with two knobs for convenience in sliding.

The device is held in the machine vise at the desired angle, having been set by a protractor. Depth of cut is controlled by the cross-feed of the machine.



Holes in Laminated Wood

CHARLES WESLOW

I was given the job of drilling holes 0.060 in. in diameter into some ¼-in. laminated wood panels. The holes were to be located within 0.003 in. of the figures given on the print.

I made a jig with the holes in it 0.001 in. oversize and properly located it on the panels with clamps. Then I made a tool as illustrated and held it in a drill press chuck revolving at about 250 r.p.m. A quickly evaporating fluid was used as a lubricant so that the glue would not get soft.

The tool would cut into about half the depth, and then I picked out what was cut easily with a pen knife and then cut the rest of the hole. The cutter had no teeth on the edge and would pick up the blank when lifted. This was ejected by a piece of rubber shoved up into the recess of the cutter.

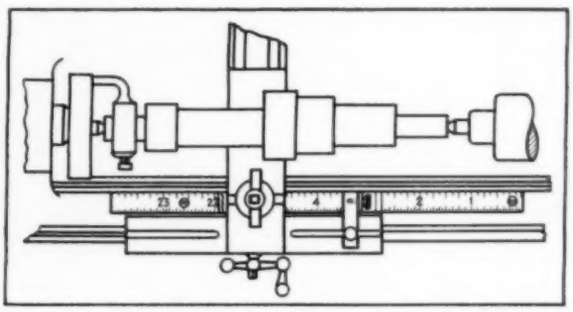
The same kind of tool works well in cutting felt, rubber or Balsa wood boards of about ¼ in. thickness.

Direct Length Measurement of Lathe Work

CHARLES KUGLER

A method of measuring the total length of lathe work, as well as the distances between shoulders, so that further measuring will not be necessary after the work has been completed, is indicated in the illustration.

A scale of sufficient length is attached by screws to the lathe bed between the V's and an adjustable gage is attached to one wing of the carriage. By setting the gage to some predetermined starting point on the scale, the carriage and, of course, the tool can be moved longitudinally a definite distance, depending for closeness on the graduations of the scale.



A scale attached to the lathe bed and an adjustable gage on the carriage will enable the operator to make direct length measurement of the work

Double-Action Tools for the Horn Press

HARRY WINK

In the manufacture of small, rectangular shells, it is often necessary to pierce holes in, emboss or otherwise mark opposite sides. The double-action tools illustrated were designed to perform any of the operations mentioned on opposite sides of the work simultaneously.

The long racks *A* are welded to the upper punch-holder and mesh with the pinions *B*, being held in mesh by the rollers *C*. As the shafts of the pinions are held in stationary bearings, it will readily be seen that as the ram descends the pinions will be rotated by the long racks and will transmit upward motion to the short racks *D*, which are welded to the lower punch-holder. Thus the two punch-holders approach each other as the ram descends and recede from each other on the return stroke.

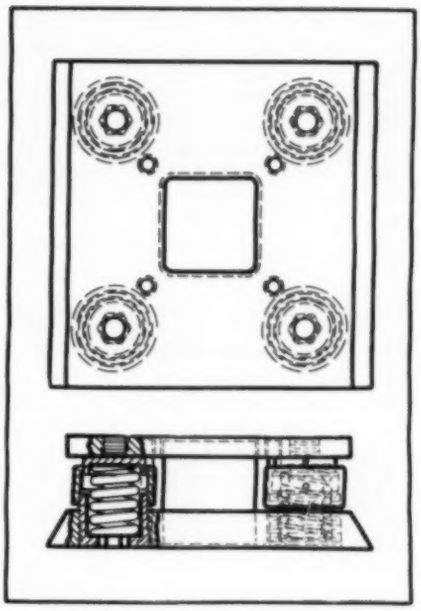


Fig. 2—One of the punch plates in which the location of the punches and the construction of the strippers can be seen

Midway between the punch-holders is the horn die on which the work is mounted. The punch plates are dovetailed and fit loosely in the holders, the spaces on each side being filled by gibs, so that by taking out the gibs the plates with their punches can be removed without interfering with the actuating mechanism, the top plate by lowering it and the bottom plate by raising it. The horn die is attached to the horn by the key *F* and can be removed by taking out the key. An axial hole in the die permits the slugs to be

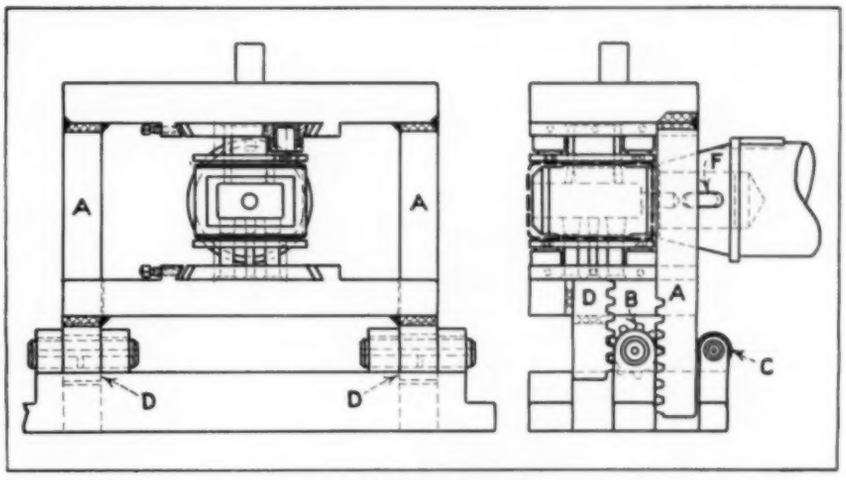


Fig. 1—By means of the racks attached to the punch-holders and meshing with the pinions, the upper and lower punches move in unison and act simultaneously on opposite sides of the work

removed either by scraping them out or by blowing them out with compressed air.

In Fig. 2 is shown one of the punch assemblies. Both the upper and the lower assemblies are of ordinary construction, except that the stripper screws are so made as to house the springs.

Simple Fixture for Splitting Bearing Blocks

F. SERVER

The function of the fixture illustrated is to hold six bearing blocks while they are being split through the center by sawing in a milling machine.

Referring to the illustration, the work, indicated by heavy, dotted lines, is located in the groove *A* and is held against the steel plates *B* by the two clamps *C*. The steel plates are set in cross grooves and are held by the pins *D*. Each of the two clamps holds one side of the blocks and prevents them from moving as the saw passes through them. The groove *F* is for clearance of the saw.

The fixture is inexpensive to make and, as the six blocks are split at one pass of the saw, the long run gives the operator time to burr the blocks between loadings.

Precision Bench-Gage

C. E. WALTON

The bench gage illustrated employs a long lever and a dial indicator and is very sensitive. The fulcrum screw for the lever is tapered, as is the hole in the lever, permitting any wear to be taken up. Since the end of the body is square with both the anvil and the short end of the lever, if the piece being gaged is held firmly on the anvil and square with the end of the gage body, a true radial measurement can be made.

For calibration, the piece to which the anvil is attached can be moved up or down the bracket, the holding screws passing through an elongated slot. Likewise, the dial indicator can be adjusted on its bracket. The light spring *A* is located under the lever near the fulcrum to compensate for the weight of its long end.

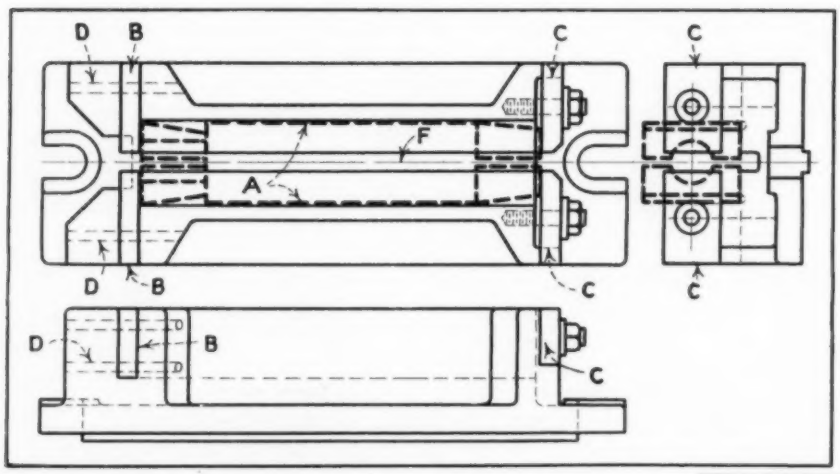
While the gage is intended for internal measurements, the wall thickness of tubes and bushings and the thickness of sheet metal can be gaged by holding the work lightly against the under side of the anvil. For gaging job lots, a gage of this type is superior to plug and snap gages, as it shows any variation in size.

A Handy Toolroom Accessory

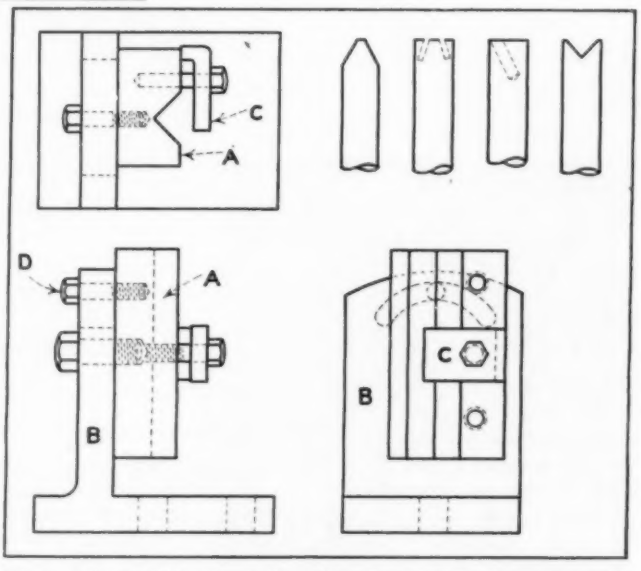
PETER L. BUDWITZ

In the illustration is shown a fixture for holding round work that is to be machined on the ends. It consists of the fairly long V-block *A* pivoted to the angle plate *B*, and the clamp *C*. A semicircular slot in the angle plate provides clearance for the clamping screw *D* and permits the V-block to be set at an angle. The work is nested in the V-block and is securely held by the clamp *C*. Additional holes are drilled and tapped in the V-block, so that the clamp can be shifted to various positions, or for the attachment of other clamps if needed.

Typical samples of the kinds of machining that can be done on the ends of work held in the fixture are shown in the upper part of the illustration. The fixture is especially useful for holding punches to be machined in intricate shapes, since it can be transferred from one machine to another without disturbing the set-up.

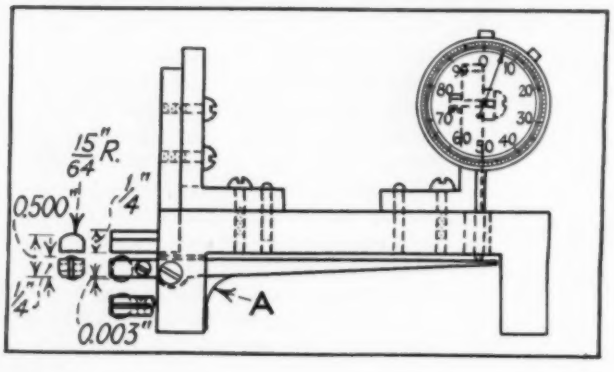


Six blocks are held in this fixture while they are being split by a saw. Two clamps hold the sides and prevent the halves from moving as the saw passes through.



Fixture for holding round work to be machined on the ends

While this gage is primarily intended for internal measurements, the wall thickness of tubes and bushings and the thickness of sheet metal can be easily measured



SHOP EQUIPMENT NEWS

"National" Precision Nut Tapping Machine

The National Machinery Co., Tiffin, Ohio, has announced a line of precision nut tapping machines for commercial tapping of Class 3 and Class 4 fit nuts. A special type of hook tap, Fig. 2, is employed to keep the tap positioned accurately for close-limit tapping. An improved type of hopper serves to turn the nuts as they are delivered to the chute, so that the nuts are presented to the tap with the bottom face against the injector. This insures the nuts being tapped square with the bottom face.

The machine is driven by a motor and is fully protected by automatic safety devices. One such device is an electric brake which stops the machine without overrun, and thus reduces tap breakage. When the machine stops a telltale light signals the operator. These machines are built in a full range of sizes from ¼ to 1 in., both hexagon and square, and they also can be arranged for tapping Dardelet nuts. The motor and all electrical equipment are furnished.

An improved lubricating and cooling system is provided that reduces the temperature of the coolant and increases the tap life. Nuts are delivered chip free.

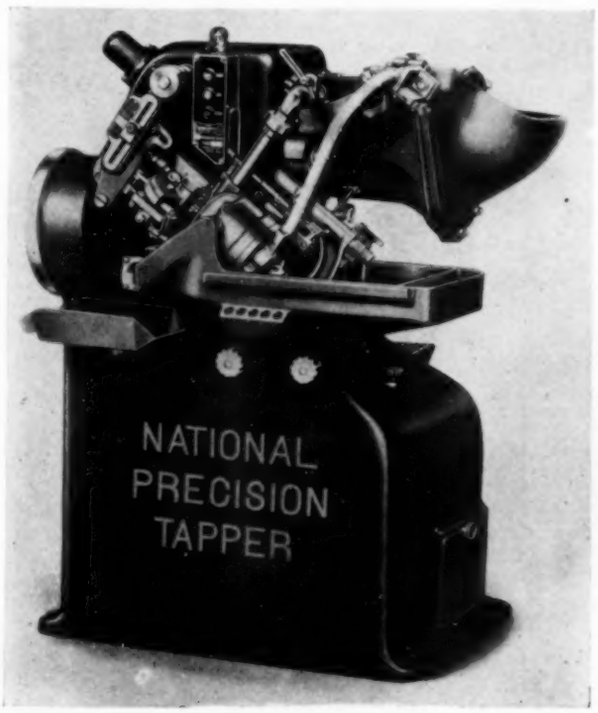
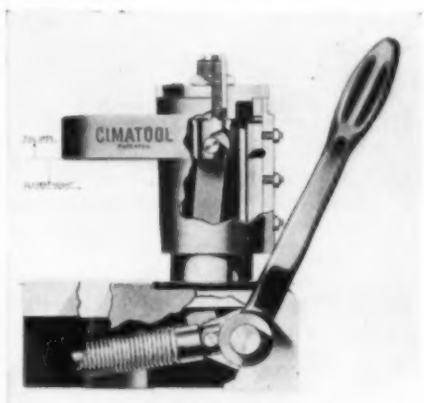


Fig. 1—National nut tapping machine for commercial tapping of nuts with Class 3 or Class 4 fit. Fig. 2—Special hook tap that has been found to give better tap life.

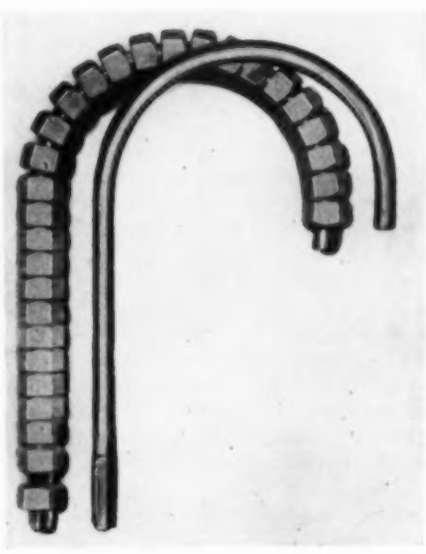
"Cimatool-Paulins" Tool Jig

The City Machine & Tool Co., Dayton, Ohio, is now manufacturing the "Paulins" tool jig, formerly made by the Paulins Tool & Engineering Co., which has been acquired by the above company. The Paulins linkage and locking designs have been retained in the "Cimatool-Paulins" tool jigs now being offered. In the spring-type mechanism the two springs exert from 0 to 105 lb. pressure. Bushing plates and other details for both the single- and double-post models have been simplified. This redesign also includes both positive-lock and spring-type mechanisms. All parts of the toggle and clamping mechanism are fully inclosed, and a larger diameter barrel increases the strength of the tool.

It is said that changes in design of manufactured parts need not obsolete a jig of this kind. The main body of the tool remains serviceable and a new bushing plate can be obtained from stock. For users who wish to utilize the Cimatool-Paulins special lock on jigs of their own design, these locks are available. In the illustration there are shown the open and closed heights of the device.



Part changes do not obsolete the "Cimatool-Paulins Tool Jig"; only the bushing plate is replaced.



Left—A large-diameter, shallow basket is used for dense loads. Above—No. 5 "Workshop" Lathe

Leeds & Northrup Special "Homo" Tempering Furnace for Dense Loads

By incorporating a fan and a different work container in its "Homo" furnace, the Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa., is in a position to offer the furnace for heating the dense loads of parts such as rivets, bolts and other small parts. Better production and uniformity of heat-treating are secured. The heated air is pulled through the work at high speed and heats all parts, at middle, top and sides, to the same temperature. Just before the work reaches the soak temperature, two-thirds of the power input is cut off automatically to prevent overshooting. At this point a "Micromax" automatic controller takes charge of the operation. Thus, the operator simply loads the furnace, sets the control and is free for other duties. The length of soak can be varied, and the soak temperature can be raised or lowered quickly.

South Bend 9-In. "Workshop" Lathe

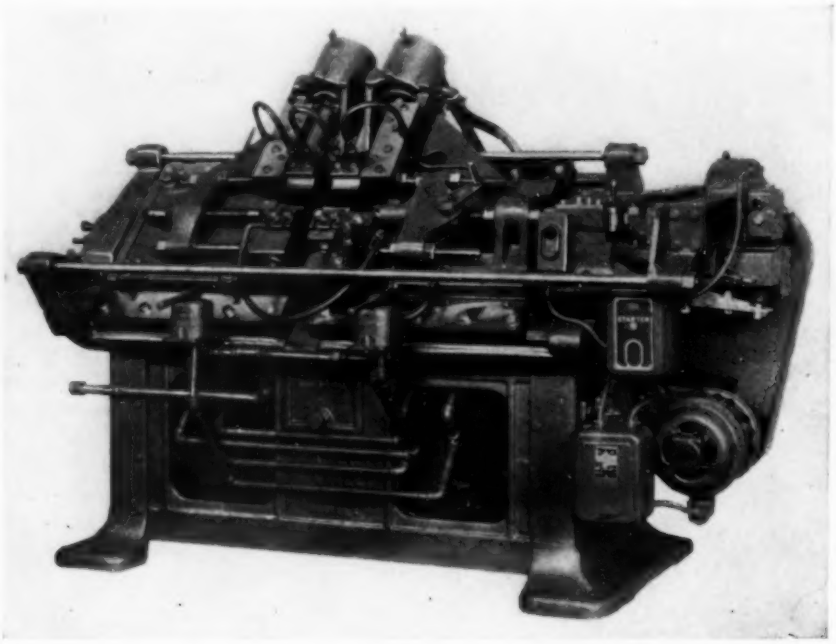
A back-geared screw cutting lathe of 9 in. swing, available with countershaft drive or with motor drive, has been announced by the South Bend Lathe Works, South Bend, Ind. Known as the No. 5 "Workshop" lathe, this machine is intended for shops requiring an inexpensive equipment. All fundamental machining operations may be performed, including the cutting of screw threads, right or left hand, from 4 to 40 per inch. Features of the lathe include: a six-speed, back-geared headstock; hollow headstock spindle for handling bar and chuck work; automatic power feed to carriage; ballcrank hand cross feed; graduated compound rest; graduated tail stock with set-over for taper turning; nickel-steel-iron lathe bed having three V-ways and one flat way.

Specifications: Swing over bed, 9⅛ in.; over carriage, 6⅛ in.; hole through spindle, ¾ in.; spindle speeds for metal, 39 to 630 r.p.m.; spindle nose, 1⅜ in. in diameter; 10 threads; head and tail stock centers, No. 2 Morse taper; automatic longitudinal feed of carriage, 0.0028 in. per revolution of spindle.

Taylor-Winfield No. B-8, 45 Deg. Automatic Butt Welder

The Taylor-Winfield Corp., Warren, Ohio, has developed a specialized No. B-8, 45-deg. butt welder for use on special alloy steels such as employed in motor valves and tappets. In designing this special welder, a high degree of accuracy was demanded, because the characteristics of alloy steels are such that the welding operation requires particular care. The design of the part welded is usually such that it can be produced on screw machines to close limits and therefore additional machine operations are not warranted after the welding operation. In other words, the proper welding heat, welding time and upset pressure must be synchronized to produce satisfactory welds.

The features of the construction of this unit are an infinitely variable speed



drive arrangement for the correct welding speed, an infinitely adjustable welding stroke to provide the correct amount of burnoff and upset, a quickly set and readily adjustable back-up stop to take up any variation in the length of the part, tie-rods aligned with the weld to eliminate distortion, and a bed plate tipped at an angle of 45 deg. for convenience of the operator. The welder illustrated has welding capacity up to ¾ in. round, or the equivalent cross-section in alloy steels.

Shaw Model "E" Blue Print Machine

Tracings up to 42 in. in width by any length can be handled, and the tracings after passing around the half cylinder of glass are returned to the operator in the Model E blue print machine. This machine, offered by the Shaw Blue Print Machine Co., 9-11 Campbell St., Newark, N. J., utilizes three General Electric vapor tube lamps. A half cylinder of curved plate glass is bedded into the end frame castings and around this glass travels an endless canvas band. Continuous travel of the band brings the sensitized paper and tracings within the printing range of the lamps. A ⅛-hp. motor drives the band and a variable-speed control gives speed variations of 6 in. per min. to 5 ft. per min. A satin-finished aluminum reflector serves to conserve the light. Blue prints, Van Dyke negatives, blue line prints, black and white prints, or Ozalid prints can be made with this machine. Total power consumption is 1,768 watts.

Skilsaw Portable Electric Blower and Suction Cleaner

Skilsaw, Inc., 3310-20 Elston Ave., Chicago, Ill., is manufacturing a portable electric blower and suction cleaner in five models for cleaning dust from motor windings and cleaning about machinery. The device can also be used to operate a paint sprayer or blowtorch. The models can be equipped with electric heaters for blowing warm air. Air is delivered at high velocity. A ball-bearing motor is used in each model.

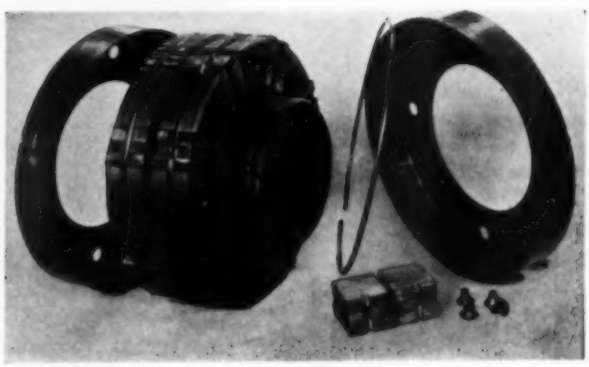
Improved "Favorite" Reversible Ratchet Wrench

Greene, Tweed & Co., 109 Duane St., New York, N. Y., is now using a stronger metal for the handles, heads and pawls of the "Favorite" reversible racket wrench. In addition a regrouping has been effected of the handles and heads to avoid awkward combinations and duplications. A cadmium finish has been applied to improve the appearance and increase the weatherproof protection.

"Favorite" Reversible Ratchet Wrench for heavy-duty nut turning which is now made of stronger material. Note how the bolt passes clear through the head

Westinghouse Type WH Flexible Couplings

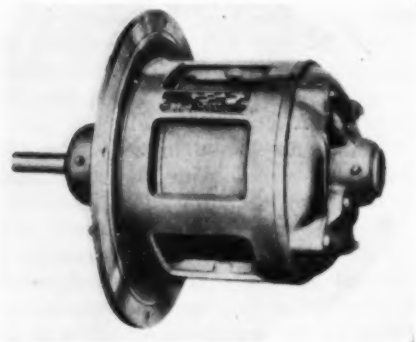
The Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., is introducing a Type WH coupling, consisting of two cast-steel flanged halves, two sheet-steel cover plates, two snap or retaining rings and from five to twenty-two flexible elements, depending on size. Machined radially around the periphery of each flange are rectangular slots to receive the cushioning and torsionally flexible elements. The torque transmitting element is a rectangular steel plate and the cushioning elements are made from hydraulic packing. In assembly, the torque elements are placed in the center of a slot with a cushioning element on each side. Thus, the cushioning elements are subjected only to compression under load. The flexible elements can be removed and replaced without disturbing the coupling flanges. The coupling can be used for speeds up to 8,000 ft. per



min. Horsepower ratings are 1.87 to 1,870 hp. per 100 r.p.m. Shaft diameters range from 1 to 10 in., and weights from 6 to 3,115 lb.

Allis Flanged-Head Motors

Several types of flanged-head mountings for its electric motors are announced by The Louis Allis Co., Milwaukee, Wis. Illustrated is a flange made as an integral part of the motor head, and this type may be finished on either or both sides. Limitations in space for motor mounting on such applications as machine tools make it desirable to eliminate motor feet and to provide a finished flange on the motor head for end mounting.



Defiance No. 60 Oil-Groove Grinder

For grinding grooves in hardened pins, shafts and other parts for oiling purposes, a No. 60 grinder has been developed by the Defiance Machine Works, Defiance, Ohio. This machine may also be used for grinding flat spots, cutting off and for similar operations where a high-speed grinding wheel or abrasive cut-off wheel is required.

A swinging arm carries the grinding wheel spindle. Drive to the spindle is by V-belts from a 5-hp. motor, and three pulleys give speeds of 8,000, 5,800 and 3,900 r.p.m. The swinging arm oscillates on roller bearings and is counterbalanced to lift the grinding wheel from the work. Either a treadle or hand lever may be used for advancing the grinding wheel to the cutting position. An adjustable screw stop regulates the depth of cut. The maximum vertical movement of the grinding wheel is 6 in., and an adjustable stop is provided to regulate the amount of movement.

A pivot supports the swinging arm and permits the grinding spindle to be positioned so that its center may be either parallel or at right angles to the direction of travel of the table, or it may be set at any intermediate angle. Maximum table movement is 16 in. Floor space occupied is 60 in. x 60 in., and the net weight is 1590 lb.

Grooves in pins, shafts and other parts are ground for oiling purposes on this Defiance machine.

"Airco" Portable Tensile and Bend Testing Machine

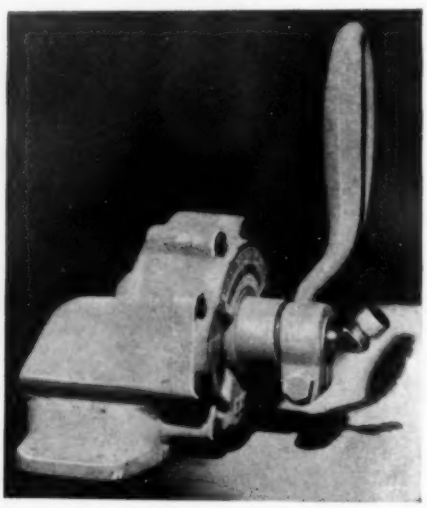
A compact testing machine that can be carried to the welding job is now being introduced by the Air Reduction Sales Co., 42nd Street, New York, N. Y. Essentially the machine consists of an oil pump, a hydraulically actuated piston or ram, two heads, one fixed and one movable, and four symmetrically located steel shafts, two of which transmit the piston motion and load to the movable head. The other two shafts maintain the alignment to the two heads and prevent the introduction of bending stresses in the tensile-test specimen. The load on the specimen is indicated by a 6-in. pressure gage. With a few strokes of the operating lever, the operator can apply a direct load of 40,000 to specimens from 9½ to 10 in. long, up to ½ in. thick and to 1½ in. wide. By using specimens of smaller cross-sectional area, loads equivalent to 150,000 lb. per sq.in., or higher, can be applied.

For the bent test, the machine is provided with an anvil that fits into the movable head and that bends the specimen against a pair of supports.

Hanna Manifold Valve

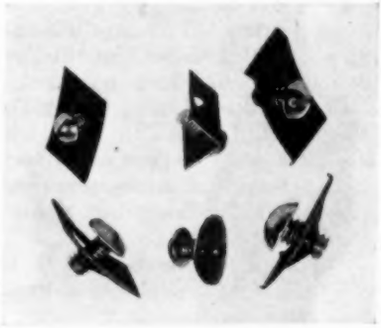
The manifold valve introduced by the Hanna Engineering Works, 1765 Elston Ave., Wicker Park Station, Chicago, Ill., is particularly adaptable to installations where a number of valves must be located close together. Necessary piping to and from the valves is possible without interference with the piping of adjoining valves. Valves of this manifold type may be arranged so that their intake and exhaust openings may be conveniently connected to a single supply or exhaust pipe, either directly or by means of a manifold or pulpit block.

Between reversals, the valve disk rotates on two eccentric points while in contact with its seat. Circular lines of contact or scoring do not develop. Balanced disk pressure throughout the contact area is attained by the arrangement of the seat ports and disk pockets. The valve disk is seated on the valve bonnet, and therefore when renewals are necessary they can be made quickly without removing the valve body from the pipe line.



Tinnerman "Speed Nuts"

The Tinnerman Stove & Range Co., 2038 Fulton Road, Cleveland, Ohio, is marketing "Speed Nuts" to replace an ordinary nut and lock washer. In use, the speed nuts are flipped over the threads of the machine screw or bolt and with a turn or two of the screw driver, they are locked securely in place under constant spring tension. If the speed nuts are used in connection with



vitreous or vitreous-coated parts, they hold them under a cushioning tension without causing breakage of the coating.

Speed Nuts are made from high-carbon spring steel, tempered to provide resiliency and holding power. On the Type B nut, the corners are turned down to form small locking prongs. These prongs eliminate rotation of the nut during the tightening operation. Speed Nuts are made at present in many special shapes.

DeVilbiss Type MBC Spray Gun

Designed for production finishing operations, the Type MBC Spray Gun, introduced by The DeVilbiss Co., Toledo, Ohio, may be used with pressure, suction or gravity material feed. The air cap includes an increased number of openings, thus permitting better atomization of lacquers, primers, surfacers, sealers and ground coats. The spray width adjustment valve on the back of the gun is dialed to permit easy adjustment of the proper setting for each finishing operation.

Hart Mercury Switch

A switch for use on machines where automatic control is desired has been developed by the Hart Manufacturing Company, Hartford, Conn. This switch is arranged so that the mercury tube can make or break the circuit by the action of the plunger in contact with cams, levers or gears on the machine.

It is also used to control motors that must be stopped during or after a machine operation, and as a limit switch for motor-operated mechanisms. The plunger may be left off entirely and the switch arranged to make and break by a rocker movement. The two sizes built are 10 amp., 125 volts, and 30 amp. 125 volts.

General Electric Automatic Arc-Welding Head

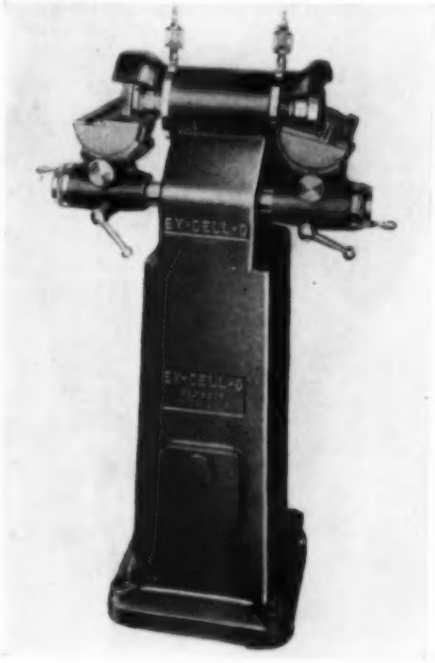
An improved Type WFA automatic arc-welding head is now available from the General Electric Co., Schenectady, N. Y. One small motor drives the electrode feed rollers through a worm reduction gear and three-speed transmission. At any of the three speeds, selected to suit electrode size, current and rate of deposition of metal, the electrode is fed at a uniform rate and the arc voltage is maintained. A rheostat is the only adjusting element necessary.

Hand wheels swing the nozzle through the complete circle in two planes at right angles to each other, thus permitting universal motion of the head. This feature allows quick positioning of the electrode with respect to the work or for following an irregular outline as the weld progresses.

Ex-Cell-O Improved Grinding and Lapping Machine

Sharpening of cemented-carbide-tipped tools is the function of the improved grinding and lapping machine placed on the market by the Ex-Cell-O Aircraft & Tool Corp., 1200 Oakman Blvd., Detroit, Mich. Through the use of hardened and ground plates on the surface of the tables at each end of the machine, greater accuracy can be maintained. These strips reduce wear on the table surface, and are mounted on adjustable "U" shaped tables, have a horizontal micrometer adjustment. Since two of the strips are mounted parallel with the face of each wheel, they form a slot which acts as a guide for the tool support. Across the ends of each table and in front of each wheel is mounted another hardened and ground plate. U-slots are machined lengthwise in each strip.

The spindle carries a ring-type grinding wheel at one end and a special cast-iron lapping disk at the other end. Both wheels are 6 in. in diameter. The motor is rated at ¾ hp., 3,450 r.p.m. Dust caps protect the bearings from dirt.

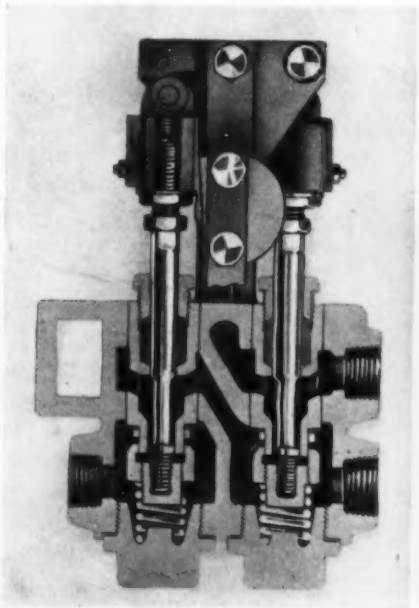


Chase Nickel-Aluminum Bronze

Greater corrosion-resistance and better physical properties are claimed for the nickel-aluminum bronze now manufactured by the Chase Brass & Copper Co., Waterbury, Conn. This material is a composition of approximately 92 per cent copper, 4 per cent nickel, and 4 per cent aluminum. Can be supplied in tubing, pipe, sheet, rod and some wire sizes, has good cold working properties and is ductile. Rods can be drawn to a tensile strength of about 100,000 lb. per sq.in., and yet remain ductile enough to be cold headed and roll threaded for manufacturing bolts. The hardness, when measured on the Rockwell F scale, varies between 70 and 110, depending on temper. Tensile strength ranges from 50,000 lb. per sq.in. in the soft annealed condition to 115,000 per sq.in. for hard rolled sheet, and to about 150,000 lb. per sq.in., for very hard-drawn wire. At 20 per cent reduction in area for drawn rod and tubing the accompanying properties are: tensile strength; 70,000 lb. per sq.in.; elongation 35 per cent. At 50 per cent reduction in area the tensile strength is 95,000 lb. per sq.in. and elongation 16 per cent.

Homestead Protected-Seat Hydraulic Operating Valves

The Homestead Valve Manufacturing Co., Coraopolis, Pa., has developed a line of hydraulic operating valves in which as the valve stem moves down with the closing of the valve, practically all flow of water is cut off by a closely fitted sleeve around the seat and a closely fitted plunger inside the neck of the seat or seat bushing. Consequently, the seating elements make contact with practically no water flow and the result is lower maintenance. Valves are built in three-way and four-way types, and are suitable for controlling single- or double-acting pistons required to travel the full length of the stroke at each operation, or for stopping, alternating or changing the direction of flow at any point.



Black & Decker 1/4-In. Special Electric Drill

Increased power and anti-friction bearings are two features of the ¼-in. special electric drill built by the Black & Decker Mfg. Co., Towson, Md. Armature and chuck spindle are mounted on ball bearings. Universal motor is furnished for all voltages. Complete weight of the tool is 5¾ lb.

"Flexi-Grip" Tool

For starting or removing nuts, bolts, cotter keys, rivets, and other parts in inaccessible places and around corners, or in places too small for fingers or wrenches, a "Flexi-Grip" tool is being offered by the California Sales Co., 11 Front St., San Francisco, Calif. Manufactured in 8, 12 and 18 in. sizes, this tool has claws that take a powerful grip on a nut or rivet, but add only ⅛ in. to the cross-sectional diameter. Uniform pressure on the four claws enables the "Flexi-grip" to handle fragile pieces.

• TRADE • PUBLICATIONS

BEARING BRONZES. The U. S. Department of Commerce, Bureau of Standards, has published Research Paper RP665, entitled "Thermal Expansion of Bearing Bronzes," by Peter Hidnert. The pamphlet is for sale by the Superintendent of Documents, Washington, D. C., for five cents.

BELT LACINGS. A 72-page illustrated textbook entitled "Short Cuts to Power Transmission," has been published by the Flexible Steel Lacing Co., 4607-31 Lexington St., Chicago, Ill. This booklet is a complete revision of an earlier title and contains all information needed in solving any ordinary belt transmission problem.

CONTROLLERS. The Square D Co., Detroit, Mich., has published a 40-page digest, giving information and prices on nearly all products manufactured by the switch and panel division in Detroit and the industrial controller division at Milwaukee.

GEARS. The Charles Bond Co., 617 Arch St., Philadelphia, Pa., has published a catalog and handbook covering stock gears, sprockets, and speed reducers. Much engineering information is included. The publication is known as Catalog No. 57.

KEYS. Catalog V—111, issued by the Whitney Mfg. Co., Hartford, Conn., lists its Woodruff-type keys and cutters.

MOTORS. Leaflet No. 2173, "Squirrel Cage Induction Motors, Type AR," has been issued by the Allis-Chalmers Manufacturing Co., Milwaukee, Wis.

MOTORS. "Linc-Weld" self-protecting motors built by the Lincoln Electric Co., Cleveland, Ohio, are discussed in a four-page pamphlet. Dimensions are given.

PLATE SHEARS. Streine Tool & Manufacturing Co., New Bremen, Ohio, has available bulletin No. 122 on sheet and plate shears. A description and specifications of each type are given.

TESTING MACHINES. Catalog H, universal impact testing machine, and Bulletin 9 (Supplement), hydraulic universal testing machines, are available from the Tinius Olsen Testing Machine Co., 500 N. 12th St., Philadelphia, Pa.

TUBE COUPLINGS. Bulletin No. 35 prepared by the Parker Appliance Co., 10320 Berea Road, Cleveland, Ohio, contains information on tube couplings and associated equipment.

TWIST DRILLS AND REAMERS. Catalog No. 40, issued by the Union Twist Drill Co., Athol, Mass., shows a large number of the twist drills and reamers regularly manufactured. The list prices are shown.